

GALILEO

EMILE NAMER



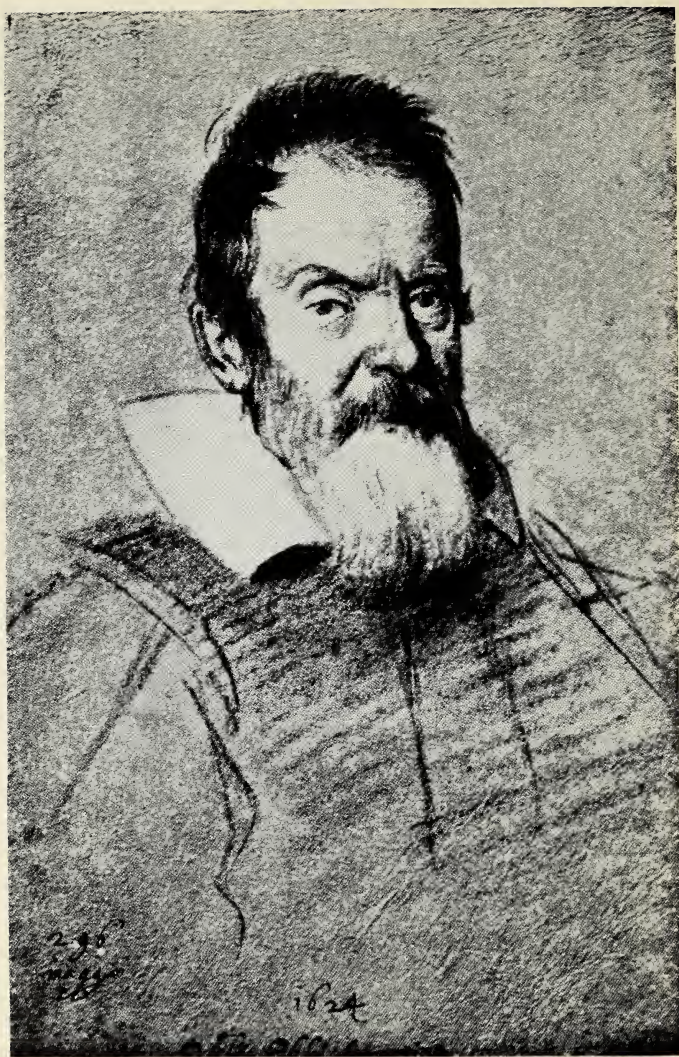
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GALILEO

Searcher of the Heavens



GALILEO AT HIS ZENITH.
(From Life after a Crayon Drawing by Leoni)

GALILEO

Searcher of the Heavens

By ÉMILE NAMER

*Translated and Adapted
from the French by*

SIBYL HARRIS

ILLUSTRATED

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GALILEO—SEARCHER OF THE HEAVENS

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To

Doctor P. L. Couchoud

*to whose encouragement
these pages are due in
affectionate admiration and
humble friendship.*

ERRATA

Page 163, line 28: 1512 should read 1612.

Page 179, line 16: 1618 should read 1615.

Page 189, line 33: 1516 should read 1615.

Page 267, line 22: second should read twenty-second.

Page 282, line 17: Pierone should read Pieroni.

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FOREWORD

MUCH has been written about Galileo, but the subject seems to me by no means exhausted. Thanks to more or less impassioned commentaries, biographers have only succeeded in further complicating a drama which needed no added intrigues. The history of his life is so poignant that it impels reconsideration. But to do so it was necessary to cut myself off, that is to say, to forget for the time being the conclusions of romancers as well as critics, of theologians as well as freethinkers, and to plunge myself into a patient and personal meditation of Galileo's works, letters and mental processes.

When this task was accomplished I had to find an angle of perspective which covered the multiplicity of events in which this stormy being was involved. That is why I have tried to enter into the very consciousness of Galileo, in order to observe his reactions towards both social customs and religious institutions, towards the trend of his age.

Independence of thought and tradition—these seem to me the two poles of this drama in which you are invited to take part; a drama which I have endeavored to relive from within before presenting it anew.

Emile Namer.

GALILEO

Searcher of the Heavens

BOOK ONE

GALILEO'S YOUTH

Chapter I

A PRECOCIOUS CHILD

PISA was no longer the ruling city of the Mediterranean, the republic which dominated its neighbors, Lucca, Pistoja and above all Florence, by virtue of its armed victories, flourishing commerce and its works of art, all conducive to exalted national pride.

By the eighteenth century it had long been nothing more than a peaceful city ruled by the Dukes of Tuscany, whose capital was Florence. Only a few traces remained of its glorious past and, here and there, of its cruelty.

The famous Hunger Tower still stood near the Place degli Anziani, formerly the forum of the town. It was so named because within its walls the Archbishop Ruggieri degli Ubaldini condemned the Count Ugolino della Gherardesca, with his sons and nephews, to die of hunger in 1288. In his *Divina Commedia* the poet, Dante Alighieri, tells us of this episode in the history of Pisa, and of the hideous spectacle of Count Ugolino driven by hunger to devour the corpses of those who were dearest to him and who had shared his fate.

Further to the west, near the ramparts but constituting an important quarter of the town at that epoch, stood a group of historic buildings: the Duomo, built in memory of a great naval victory, a magnificent marble cathedral whose façade was originally ornamented with several rows of priceless pillars; the

Campanile, the famous leaning tower which deviates from the verticle to the extent of three metres and the history of which is more or less legendary. As a matter of fact, there were other leaning towers in Italy and in France, both at Bologna and Ravenna, and it has never been known whether they leaned by accident or intentionally. Even in Pisa itself there is another of these peculiar constructions—the San Nicholas—which is regarded as a sort of poor relation.

In this same quarter there are two other architectural masterpieces: the Baptistery, almost entirely constructed of marble and decorated with little columns, and the Campo Santo, the home of the dead which skirts that of the living. Not far from this group are the University and the schools.

Vincenzio Galilei came to live in this quarter when he left Florence. He taught the theory of music and even wrote a work on the subject in later life, which was well considered. He loved literature—all the arts, in fact. He played several instruments, and his delightful conversation charmed his friends as much as the searching and melancholy sounds which he extracted from his lute.

He was poor, though of noble birth, and his profession was not calculated to bring him riches. But Vincenzio loved life and never feared its responsibilities.

He met Giulia Ammannati, a noblewoman of Pescia, and they were married before a notary in July, 1562. She brought him only a tiny dowry: a hundred gold *écus* payable within a year and inclusive of her trousseau. It wasn't much considering that the least dowry for a person of her rank was a thousand florins. Vincenzio was satisfied, however, trusting in the future.

He would work harder. Conditions were bound to improve.

A few months later Giulia told her husband that she was about to have a child. Vincenzo had to hunt more spacious lodgings, which he found in a tiny street, the Chiasso dei Mercanti. The rent was twelve gold écus a year. On February fifteenth, 1564, Galileo was born there.

Evil tongues insinuated that the new born infant was illegitimate, and later even the encyclopædist d'Alembert allowed himself to echo these unfounded rumors. Giulia Ammannati was not famous for her good character, but no known facts of her life actually reveal that her morals were light.

The first years of Galileo's life were spent in a sombre house with a mother who was none too loving. His father was frequently absent, his work often taking him to Florence. The family increased, and Galileo acquired a brother, Michaelangelo, and two sisters, Livia and Virginia.

He learnt the rudiments of grammar from a poor priest who received five francs a month for his lessons. Doubtless he suffered from the pedantry of an epoch which believed that grammar was the keystone of the social edifice. The world was what it was because these rules were neglected!

Young Galileo was often absent-minded during his classes. He had no taste for abstract syntax because he could not see the use of it in spite of the convictions of the good old priest who gave himself endless trouble with his pupil. While the master was explaining the superlative importance of an interjection, Galileo was thinking of his games, of the balloon his father had sent him from Florence. The keenness of his mind re-

vealed itself during his playtime; his idea of pleasure lay in observing objects about him. On these he could whet his imagination. With what slender means he possessed he constructed little toys resembling instruments, machines, mills, boats—anything which roused his interest during his walks.

From his father he inherited his love of life. He liked concrete things, things that could be seen and touched. But anything that struck neither his senses nor his imagination, things with which he couldn't come into direct contact, left him indifferent. It was his nature. Not a desirable nature, according to those around him, but they had to make the best of it.

Galileo was ten years old when he returned to Florence with his mother and the family. At first his father undertook his entire education, but very soon relinquished all branches except music. The child soon showed extraordinary aptitude; not that he had particular talent for that art, but simply because he applied himself with desperate ardor to things that he loved and at the contact of which he felt his mind expand. Those who heard him later say that he played the theorbo beautifully.

But unfortunately during the same period he had to submit to lessons in what were then known as the humanities, ultimately called the classics, from a mediocre teacher. Impossible for the family to employ a first-class professor with the cost of living so high and the budget so limited. Alas! the humanities, as they were presented to him, meant little to such a vital and positive mind.

The lessons included the works of Cicero, Suetonius, Quintillian, Juvenal, Ovid, Virgil, etc. The harm might not have been so great if the pupil had not been

forced to learn the texts by heart and then analyze them grammatically, hunt up the unusual words and memorize all the proverbs. Ideas played no part at all in the official teaching of those days. They were completely subordinated to phrases and empty words. There are no traces of creative thoughts or experiments; merely language allied to grandiloquence, with no consideration for the childlike questionings of the schoolroom.

While he was still very young, Galileo took refuge in dreams during his grammar lessons. But as he grew older he began to appreciate his father's sacrifices. He felt he must benefit at all costs by this unprofitable instruction which was so alien to his nature. He owed most of his literary development to his own initiative. Ultimately he ceased cultivating the Latin scribes. How could they interest an intelligent mind? Instead, he became absorbed in the works of Tuscan authors—Dante, Petrarch, Boccaccio, even Ariosto and Tasso, who also wrote in Italian, the vulgar language disdained by the pedants, but so pleasing to Galileo's ears.

After this trying period, he encountered worse! He was sent to the Benedictines of Vallombrosa, near Florence. There he had to submit to the teachings of logic, the boredom of definitions and distinctions, and an empty and tedious scholasticism. The influence of his new surroundings was such that he very nearly entered the religious order, and even wore the novice's robe for some time after. He might have succumbed entirely, had it not been for his father's clear-sightedness.

Galileo owed much to his father. It was thanks to his contact with that very human being that he learned to develop his intelligence and find pleasure in music.

He probably owed his knowledge of drawing and painting to the same source. He excelled in these arts, and enjoyed them so much that he might have made them his profession had he been in a position to choose.

The number and variety of the disciplinary measures through which he passed seem surprising, but are not really to be wondered at. In those days the Florentine nobility learnt drawing and architecture as a matter of course—not as professions, but in order to build their own homes with taste, design graceful furniture and surround themselves with beauty.

Chapter II

THE STUDENT

VINCENZIO GALILEI definitely decided that his son was to be a doctor. It was a lucrative profession, and besides procuring him the means of living comfortably and easing the financial situation of his family, it might give him the sort of activity which would be in keeping with his passion for observation.

With this object in view he planned to send him to the University at Pisa. He was to be under the watchful eye of old Muzio Tedaldi, a relative attached to the local custom-house.

But the expenses were a serious problem. He hoped against hope that his son might be admitted to the Sapienza, an establishment where forty pupils of the Faculty were fed and boarded free of charge.

Muzio Tedaldi gave him every encouragement, generously offering the hospitality of his home in case there should be no room for Galileo at the Sapienza.

This was in April, 1578. Three months later Muzio Tedaldi wrote asking Vincenzo not to send his son that year because times were particularly hard and grain was only fetching fifteen francs a sack in spite of the fact that the harvest was meagre.

The boy was only able to leave three years later, but the momentous day dawned at last. He loaded his bag of linen and books on his horse and galloped off to Pisa.

The trip was long and trying, but the prospect of a new and interesting life gave him the courage to go on. He was happy.

Reaching Pisa at the beginning of September, 1581, he lost no time before applying for matriculation. Two of his masters there are worthy of mention—Andrea Cesalpino, doctor of medicine, who was the first to recognise the sex in flowers, and Francesco Buonamici, professor of philosophy.

At that time the teaching of philosophy also comprised all the other sciences: physics, biology, cosmography, astronomy, etc. But if any spirit existed in those lessons it can only be called intolerant. Nowadays it is impossible to realize that human thought can have been so completely sterilized throughout centuries by the annotations of the works of Aristotle. It was taken for granted as an article of supreme faith that everything this master of the Greek antiquity had ever said was irrevocable and final. Nothing remained to be discovered! The professors were under the absurd obligation of explaining Aristotle's thoughts, chiefly through secondhand textbooks, and should some enterprising spirit dare raise an objection, the professor got out of it as best he could by setting forth the peremptory argument that the Master had said that it was so. *Magister dixit!*

These were the first facts that Galileo gathered during his student life. While following the lectures on medicine according to the worldly traditions of Hippocrates and Galen, he managed to absorb the prevalent philosophy, and avidly copied out the subjects of all lectures.

He soon found out that the teachings of science were worth as little as those of the humanities; that all in-

dividualistic ideas were excluded or treated as insolence, and that they must be hidden as if they were a proof of inferiority.

Galileo felt restless. He didn't enjoy studying. This was not what he had expected from the University. Was he costing his poor father eighteen francs a month merely to listen to these dried up, out of date commentaries which dulled his brain and depressed him unutterably? To say nothing of the price of books and other unavoidable expenses. As a child the games he had thought out had given him infinite pleasure. When he drew or painted, or when he made music, he was strangely happy. But it wrung his heart to waste time copying the lectures of Aristotle. He hated blind statements. He wanted something more than that—rigorous demonstrations, experimental proofs.

But Providence, which sometimes comes to the aid of really good will, stood by the young medical student. As often happened, the Court of Florence was transferred to Pisa for a short period. Ostilio Ricci, a friend of Galilei's, was attached to the suite as mathematician to the Grand Duke's pages.

Here was an intelligent man who had partially broken away from the prejudices of his epoch. Naturally young Galileo saw a great deal of this friend of whom his father had spoken so highly. During their conversations Ricci was struck by the boldness and accuracy with which the boy reasoned. He became attached to him, and one day he asked him what master had taught him to think on such lines.

The boy was silent for a few moments. With great delicacy he answered that until that day he had not met a worthy master. Then he poured out his heart to Ricci and spoke of his bitter disappointment. So much

had been told him of the importance of geometry and mathematics and the other sciences which were the foundation of harmony and design. These were the studies that attracted him most. But he knew of them by name and hearsay only. His last hopes were placed in them, and he implored Ricci to come to his aid and initiate him into these branches of knowledge.

Ostilio Ricci was nothing loath, but he felt certain scruples. Given his mentality, Galileo would probably abandon the desert of scholastic writings in order to plunge himself into mathematics, which alone were capable of satisfying his need for precision and creative thought. But such forms of mental activity would never make a living for him, and Galileo was expected to support his family some day by the practice of medicine.

Ricci consulted Galileo's father, not wishing to assume the responsibility alone. He pointed out the boy's dispositions and the unusual promise which they indicated. Ultimately it was understood that the father was willing to shut his eyes to his son's new line of research, so long as he continued his study of medicine at the same time.

No sooner had Galileo tasted the joys of geometrical demonstration than he realized that up to that moment he had been wasting his time. The exact sciences were made for him. With the enthusiasm of a neophyte he lost himself in the first books of Euclid and the treatises of Archimedes, without daring to confess even to himself that he was totally neglecting medicine and Aristotle.

His father soon noticed it, though! He paid him a surprise visit and reproached him severely. Galileo was forced to study his preferred subjects clandestinely,

concealing his theorems under the tomes of Hippocrates and Galen.

Scoldings and threats were of no avail. He was master of his own vocation. He refused to listen to the voice of wisdom. With great regret Ricci was forced to abandon him in order not to compromise the future and well-being of this prodigious student.

Left to his own devices, Galileo continued mulishly on the new path that had been opened up to him. While absorbing Euclid he also studied Archimedes, generally neglected, whom he loved because he found in him an observer of nature, a man who justified his conclusions by calling upon proofs and not upon authorized hearsay.

One day he read that Hiero, the Tyrant of Syracuse, suspected his goldsmith of substituting the gold in his crown with an equal quantity of silver. Hiero commissioned Archimedes to discover the fraud while leaving the crown intact. After many fruitless days of research the latter solved his problem while in his bath. He noticed that in the water his limbs became lighter. To him it was the key to the problem.

This curious story struck Galileo, who wondered how the scientist of Syracuse had arrived at his conclusions. He pondered over it deeply, and reconstructed the experimental demonstration of the principle according to which the loss of weight of a body plunged in liquid equals the weight of the liquid displaced.

By taking the density of water as a unit, it was easy to discover the relative consistency of the gold and silver and prove the famous theft. Obviously the displacement of water differed according to whether the crown were in solid gold, or mixed with silver—al-

though in the air the weight was the same. Measurement of the amount of water displaced proved the extent of the larceny.

Galileo wrote a treatise on hydrostatics called "The Little Balance," in which he gave, with full details, not only the experimental demonstration of the principles of Archimedes, but also a table of specific weights of the principal simple bodies known at his time.

Chapter III

THE SECRET OF A LAMP

ARCHIMEDES' thoughts exercised a profound influence over Galileo, and it is easy to understand why. For the first time since he had inscribed himself at the Faculty of Arts he came across someone who urged him to observe and analyze the world instead of turning his back on it.

This was entirely according to his tastes. It reminded him of his childhood days. It made him happy.

What intrigued him most was the thought that Archimedes had discovered one of the foremost laws of physics while in his bath. There he had no books, no University robes—he was completely naked!

This made him realize that it was in the book of life that truths were to be found; not among accessories and tomes. He need only take the trouble to scrutinize nature, and the least details might have incalculable value and bring about the most profound philosophical speculations. He made up his mind to keep his eyes open, to let nothing escape him, and to do deliberately what he had hitherto been doing spontaneously for his own pleasure. His program henceforth was to control the statements in books by experiments. He would possess the world, instead of submitting passively to its imprint.

So instead of attending his professors' lectures, he was to be seen ambling through the streets of Pisa

and the surrounding country. And it was perhaps that rural school which taught him best to meditate on realities instead of drugging himself with words.

One day in the cathedral he was distracted from his prayers by a commonplace occurrence which was of no interest to the faithful, and which had passed unobserved throughout the generations. An oil lamp had just been fed by the sacristan. Careless, like all sacristans, he had left it swinging, indifferent to the fact that the noise of the chains might disturb the devout.

The ticktack of the lamp may have been an annoyance to some kneeling neighbor, but to Galileo it was a flash of light. It revealed to him a rhythm, a regularity in its going and coming, showing that the two halves of the semicircle involved in its motion were covered in equal time in spite of the progressive slackening of its activity. Great or small, were the oscillations of the lamp really taking place in the same periods of time? This observation seemed to him so miraculous, so unbelievable, that for a moment he thought it was an hallucination.

He rushed home, and on the way tried to figure out a simple method by which to verify what he thought he had discovered.

Taking two threads of the same length he attached a piece of lead of the same weight at the end of each. The other ends of the threads he attached to separate nails so that they could be swung freely. Thus he had two pendulums which reproduced in theory the chains of the lamp, but in duplicate.

Why two? It was in order to compute the oscillations of the lamp simultaneously under varying conditions.



PISA, SCENE OF GALILEO'S EARLY DISCOVERIES.

*A Swinging Lamp in the Cathedral (Center) Led to Experiments with the Pendulum.
From the Leaning Tower (Right) He Demonstrated the Laws of Velocity*

He asked his godfather, Muzio Tedaldi, to help him in his experiment. The old man thought him queer, but consented.

Though drawing the first pendant two hand's breadth, and the second only one hand's breadth, from the perpendicular, the two should nevertheless arrive simultaneously at a standstill if Galileo's reasoning were correct.

Galileo himself counted a hundred oscillations of the first pendant, while the old man counted a hundred oscillations of the second. Yes, they arrived at the same point at the same time, in spite of the great difference in their starting point.

Galileo leapt for joy; but old Muzio, in spite of his love for the boy, probably laughed up his sleeve at these strange antics which seemed to him a decided indication of mental abnormality.

Having assured himself that the oscillations of pendants of the same length were isochronal, Galileo asked himself whether it were possible to establish a relationship between the length of the threads and the duration of each vibration. He noted that the shorter they were the more rapid their oscillation. But what he really wanted to do was to determine the precise relationship between the two periods.

With endless patience and ingenuity he at last established the fact that even when one pendant was four times longer than another, the duration of the oscillation of the first was only double that of the second, no matter how great the difference in radius might be.

This discovery, the wealth of which has not been exhausted even in our time, Galileo applied to medical research. He adapted it to the counting of pulses, as

we still do, and later to clocks and the measurement of time. But above all to his astronomical studies: to the exact forecasting of eclipses and other celestial phenomena.

Galileo was now twenty years old. At first he met with complete indifference or even hostility. But soon he astonished the doctors to whom he brought practical demonstrations in place of abstract propositions. In those days, as to-day, mediocre minds were able to grasp only that which was immediate and applicable. They were incapable of looking ahead; therefore they were astounded. For the moment they bowed down before the young prodigy.

While the crowds were marveling, Galileo was absorbed in calculating the why and wherefore of his observations. He noted that great secrets could be gathered from the least things merely by keeping his mind in a constant state of watchfulness and applying a rigorous formula to his experiments. He became more and more convinced that the science of mathematics was the language of nature, and that the application of numerical relations to his observations was the only ultimate way to determine the laws of the universe.

He continued to delve deeper and deeper into this science of which Ostilio Ricci had taught him the elementary facts. He succeeded in inventing several theorems on the centre of gravity in solid bodies. From the end of December, 1587, he corresponded on this subject with some of the best mathematicians of the century: Giuseppe Moleti, lecturer at the University at Padua, who testified that the propositions of his young correspondent were remarkable; Father Cristoforo Clavio, professor at the Roman College belonging

to the Jesuits; and Guidubaldo del Monte, author of several important works.

Galileo successfully defended his demonstrations against all these eminent men who recognized the value of their young associate's ideas, but who criticized some of his conclusions. His fame grew constantly. It was obvious that the science of mathematics was his true vocation, and in spite of his father's opposition, he longed to make it his profession.

Chapter IV

THE STRUGGLE FOR EXISTENCE

GALILEO left Pisa, and although he still held no doctor's diploma, he managed to get a position as lecturer on mathematics at Siena.

At the same time he gave private lessons to a few noblemen and lectured at the Academy of Florence, taking as his subjects *The Divine Comedy* of Dante, of which he admired the rich poetry and the trend of thought; Tasso's *Jerusalem Delivered*, which he considered brilliant in form but basically meagre; and *Orlando Furioso* by Ariosto, which he compared to a royal gallery overflowing with statues and marvellous paintings.

But in spite of this brilliant start he saw no material future. Craving a wider range of activity, he looked around for a vacant chair which would enable him ultimately to help his family and show what he could do.

He thought of Pisa. He longed to teach at the old University where he himself had been a student, and to find himself back with his old professors, no longer as a pupil but on equal footing. He also considered Florence. The chair of mathematics at the University there was vacant and he felt himself admirably suited to hold the position. His parents and most of his friends lived in Florence, too; if he could only manage to get that chair it would justify a little pardonable pride in the bosom of his family.

But Galileo had the sense to know that he was too young to get it by his own efforts. Those who couldn't understand him didn't take him seriously. He must have the backing of influential people who had faith in him. So he called upon some of the celebrated mathematicians who had been corresponding with him. He asked for no special favors, but merely wanted to be allowed to compete under the same conditions as other applicants.

Someone suggested Bologna to him. Galileo gave in his name, accompanied by the best references. Cardinal Camerlingue, former legate of the Pope, wrote directly to the Senate of Bologna and stated that it would be peculiarly pleasing to him if they would consider young Galileo's request. Another great personage sent a certificate in due form: "Galileo Galilei, Florentine nobleman, aged about 26, well instructed in mathematical science, former pupil of Ostilio Ricci, who esteemed him highly. He was named as public lecturer in Siena. He also lectured privately, and at the same time gave individual lessons to several noblemen at Florence and Siena. He is extremely able in his own speciality as well as others, especially literature and philosophy. He is requesting the chair of mathematics in your town, and is prepared to compete with any other candidate of his profession in order to prove his merits."

Had the chair at Bologna been vacant as was supposed, recommendations like these would certainly have borne good fruit, but as a matter of fact the chair had never been given up by Magini, as it should have been. Magini was unsatisfactory. He repeated himself, he was dull, he had difficulty in answering intelligent objections, and he made no experiments. The Senate of

Bologna intended to cut out this branch of learning which brought no honor to their University, and they did not intend to renew Magini's contract when it expired. But this date was still far off, and Magini was still occupying the chair in 1610, twenty years later!

So all these efforts had been in vain and it was necessary to pull other strings. Galileo appealed to those likely to be most useful, particularly Guidubaldo del Monte, then actually in Florence and in high favor with the Grand Duke Ferdinand. He asked him to plead Galileo's cause with His Grace and try to secure him the position at the University at Pisa.

After innumerable formalities, to say nothing of alternating periods of hope and despair, the idea had to be given up. The monk who held the post at the moment had had other plans in view, but had changed his mind and kept his position.

Galileo seemed to have no luck. But nothing discouraged him. Why not reestablish the lectureship of mathematics at Florence?

Renewed efforts; fresh recommendations. Guidubaldo del Monte sent Galileo the following very touching and kindly letter to prove that he was doing his utmost: "I have written urgently to His Eminence Francesco del Monte on the subject of the position you desire in Florence. If my words carry any weight you will certainly have it. I am deeply sorry that you did not obtain the position in Pisa which we both desired. Never fear to tell me what I can do for you. I shall always be ready to serve you with all my heart."

But things dragged on. Guidubaldo worried about it as much as Galileo. "If it seems to you that I can do even more for you," he wrote, "I shall not fail to carry out your requests with all the means in my power."

To tell the truth the public didn't think much of mathematics. They were considered very much as Asiatic folklore might be considered in a provincial University nowadays. Probably Galileo might have waited for ever if the monk at Pisa had not changed his mind again and definitely decided to give up his chair.

Young Galileo was named in his place; but it took two years of struggle to settle the matter definitely. By then it was the autumn of 1589.

He longed to start work. The lectures were supposed to begin early in November and he planned them with considerable enthusiasm.

Unfortunately the Arno was in flood just on the eve of his departure. News of difficulties reached Florence. The roads were impassable. Hopeless to try and make the trip on horseback. Galileo had to wait several days.

Not only was he restless and worried, but it cost him part of his pay—for such was the rule of the University of Pisa.

And what pay! Galileo was to receive sixty florins a year. That was all the teaching of mathematics, physics, mechanics and astronomy combined was worth at that time. Whereas the doctors of the theory of medicine, common philosophy and civil rights, received as much as five hundred to six hundred and fifty florins.

How was he to live on five florins a month? It was like asking somebody nowadays to live on five dollars a month. Decent lodgings could be had at that time at anywhere from twelve to fifteen florins a year, but what cost so much were the necessities—clothes, books, furniture, everything that was manufactured.

The only way out was to find supplementary work—private lessons to begin with, and ultimately medical practice. It has never been known whether Galileo was

a good doctor, but it is known that he had to beg his father urgently to send him his treatise by Galen which he had left behind. He probably had to consult it pretty often.

Not only were his fees ridiculous, but at least a quarter of a florin was subtracted for every lesson he missed, besides a reduction made for his absence at the beginning of the term on account of the floods.

He had to sacrifice the last month of the term, too, in order to stay by his mother's bedside. She was thought to be dying. His father, his sister, or his brother, might well have taken his place, seeing that he was so busy and that he had no right to compromise his career. But how could he bring himself to desert her? She hadn't been very gentle with him, but he loved her just the same and he wanted to be beside her until the end.

The whole thing was a false alarm anyway. Giulia Ammannati got well and lived on for many years. But what did he care for lost fees as he watched his mother regain her health?

Apart from the floods and his mother's illness he had another adventure—perhaps the queerest of all. Galileo had a friend, a charming man but full of fantastic ideas. Giovanbattista da Ricasoli spent his life reading and studying and was one of Galileo's greatest admirers, and also one of the first to bear witness to his works. They often went for walks together; Galileo would tell him of his researches, his hopes and even his fears. His friend listened to him and encouraged him. Sometimes his trend of thought was unusual, witty and even bizarre. However, he amused Galileo.

Then one day Ricasoli showed distinct signs of mental disorder. He imagined himself persecuted;

everybody around him was an enemy. Impossible to reassure him. All arguments and pleas were hopeless.

Once he wouldn't let Galileo go home. He told him a long story: he was in danger of death, he said, for having broken some law against the Inquisition and the Faith, and for having pronounced a funeral oration at the imaginary burial of the Grand Duke—though the latter was still alive. He expected to be condemned to the stake and die an ignominious death.

Next day Ricasoli appeared dressed all in black. He wanted to wear mourning for himself because the family would not be allowed to do so in the event of his capital punishment. And it was in these strange clothes that he left his house and ran about the streets of Florence.

Another time, coming back with Galileo from a walk, Ricasoli ran ahead, arriving at his house out of breath, shouting, "Help! Galileo is being attacked by bandits!"—causing great alarm among the serving-men who rushed to help Galileo with swords and shot-guns, and almost killed a friend who had stayed behind with him.

At last Ricasoli took it into his head that in order to escape persecution he must seek refuge in some other country. Galileo went with him to Genoa and other places. But he could not go abroad with him continually. At last one of Ricasoli's cousins, Francesco, was delegated to look after him.

During a short stay at Milan the madman made over all his goods to his cousin in due form before a notary. Obviously the family weren't going to put up with this, and his sister instituted a suit against Francesco for exerting undue influence.

Galileo was requested to appear as witness in this

strange case. They wished to prove that the procedure was null because Ricasoli was not in possession of his full senses at the time the deed was executed. Galileo testified in court and told of his relations with the unhappy man before this climax.

This bearing witness to the madness of his best friend, apart from the sadness it caused him, made him miss many of his lectures, thus further diminishing his resources, which heaven knows were slender enough.

And so the start of his career proved very uphill. His genius found itself constantly handicapped by pecuniary difficulties. But his confidence in himself saved him. His faith in the value of his researches and his studies, and in his enthusiasm rose above material handicaps. He saw himself in a prophetic vision as the future mainstay of science.

Chapter V

AN ORIGINAL PROFESSOR

BENEDETTO ZORZI, a patrician of Venice and a man known for his vast and comprehensive culture, wrote to a Florentine senator expressing his great joy on learning of Galileo's nomination at Pisa. At last a chance was to be given him to teach his doctrines in public.

This brilliant Venetian foretold a new era in human thought. He was right.

Galileo had no intention of adopting the traditional methods of which he had so strongly disapproved in his student days. It was not his way to take texts of Aristotle, turn them about in all directions, define and redefine them, and be satisfied to admit without discussion, in spite of all proof to the contrary, that Aristotle had said the last word about the nature of things. This meant merely marking time and cramming young minds with a mass of distinctions that led nowhere.

For two thousand years science and philosophy had been in a blind alley. When Aristotle had written his treatises he had based them on more or less exact observation, but the observations were at least personal. Galileo told his listeners that the mistake of their contemporaries lay in accepting without question conclusions two thousand years old, without seeking to find out the facts on which they were based.

If Aristotle had lived in our days, he said, he would have revised his doctrines himself and subjected them to new experiments. Disciples who thought themselves faithful to him were really traitors, because they did not seek to complete his work, or try to enrich human knowledge with their own thoughts and deductions.

With unbelievable audacity Galileo relegated Aristotle to dusty library shelves. He proposed to open the great Book of Nature and read its laws with fresh eyes.

Students listened open-mouthed to this daring professor who gave them no texts, but spoke with personal authority and begged them to turn to personal research and intelligent observation as he himself had done. For the first time for centuries a professor's rostrum was not encumbered by vast folios. Instead were numerous small objects so peculiar as to provoke laughter as well as astonishment among listeners accustomed to obscure profundities.

These objects which greatly amused the scholars were bits of string of different length with lumps of lead at the end of them, or small inclined planes down which little pellets were made to roll.

What! Did Galileo hope to teach the laws of movement and gravity with these funny contraptions? Did he hope to take the place of Aristotle by making fun of the Academy and the public?

When Galileo heard that all the other professors were expressing their doubts as to the conclusions of this insolent innovator, he took up the challenge. He solemnly invited those grave doctors and all the student body—in other words, the entire University—to assist at one of his experiments. But not in the customary setting. No, that wasn't big enough for him.

Out in the open, under the sky, in the vast Cathedral Piazza! And the academic chair clearly indicated for these experiments was the Campanile, the famous Leaning Tower.

The professors at Pisa, like those in all other towns, had always maintained, according to the teachings of Aristotle, that the speed of the fall of a given object was in proportion to its weight. For example: an iron ball weighing a hundred pounds, and another weighing only one pound, cast at the same moment from a certain height, must obviously touch the ground at different times. The one weighing a hundred pounds would obviously reach the earth first because it was heavier than the other.

Galileo, on the contrary, claimed that weight had nothing to do with it, and that they would both reach the earth at the same moment.

To hear such statements being made in the heart of so old and wise a city was intolerable, and it was considered urgently necessary to make a public exhibition of this young professor who thought so much of himself, and teach him a lesson in modesty that would last him the rest of his life.

Doctors with long velvet robes, and wardens who seemed to think that they were going to a sort of village fair, left their various occupations and mingled with the representatives of the Faculty, ready to laugh at the scene no matter what the outcome might be.

Perhaps the strangest point in the whole story is that it never entered anyone's head to try the experiment for himself before reaching the arena. Daring to question anything that Aristotle had said was rank heresy in the eyes of university students at this period. It was an insult to their masters and to themselves, a

disgrace that would cast them out of the society of the *élite*!

It is necessary to bear this attitude constantly in mind in order to appreciate more fully the genius of Galileo, his liberty of thought and his courage, and also to realize the profound slumber from which human consciousness had to be awakened. What efforts and agonies were necessary in order to give birth to an exact science.

Galileo climbed the steps of the Leaning Tower, holding himself well in hand in spite of the laughter and the booing of the crowd. He realized the solemnity of the hour. At the top of the Campanile he propounded the exact problem once again. If the falling bodies reached the ground at the same time he would have won his point; but should they arrive at separate moments, his adversaries would be in the right.

Everybody agreed to the terms of the dispute. They called for proofs.

The moment came. Galileo released the two balls of iron. All eyes were raised. A silence. The two balls were seen to leave together, stay together, and touch the earth together at the foot of the tower.

Amazement! Indignation! A confusion of sounds rose from this mixed and impatient crowd that had gathered together as if at a pilgrimage. Some of them had been confident that the miracle would be performed by the new prophet; others had been equally certain that he would be proven an impostor.

Galileo believed that he had triumphed. There were certainly men there of clear vision to whom the evidence was absolute proof and who recognized it as such, even though they would not admit that the truth

had been shown them incontestably by this erratic person who was not afraid of ridicule.

But they were the exceptions, and they were carried away by the obstinate blindness and bad faith of the majority, although Galileo would gladly have renewed the demonstration for those who, having eyes, had not seen.

His adversaries refused to budge, and the immediate result was that Galileo created many new enemies because he had dared to expose the ignorance of his colleagues. When a man is paid only sixty florins a year he must not have the impudence to teach lessons to recognised masters who receive at least ten times as much. They said his insolence went beyond all limits.

Galileo certainly never tried to spare anyone's feelings. Another story proves his scorn of social tact.

All professors of Pisa were supposed to wear their robes, not only when they sat in their lecture-chairs, but also in the streets.

Needless to say, Galileo frequently paid the fine imposed for breaking this rule. He thought this regulation ridiculous. The robes interfered with his movements and were not at all to his taste.

He promptly wrote several sarcastic verses against this custom, of which the following are excerpts.

*Oh, to be back in the happy days of yore,
Exempt from all malice and all fraud;
When Nature and the Heavens were our friends!
We should see the whole year round
Each and all, great and small, go bare—
So say the books that know.*

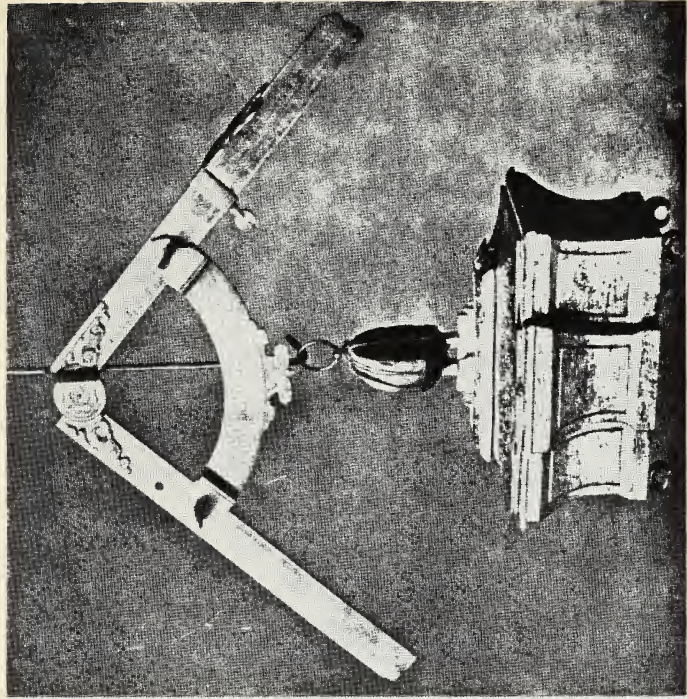
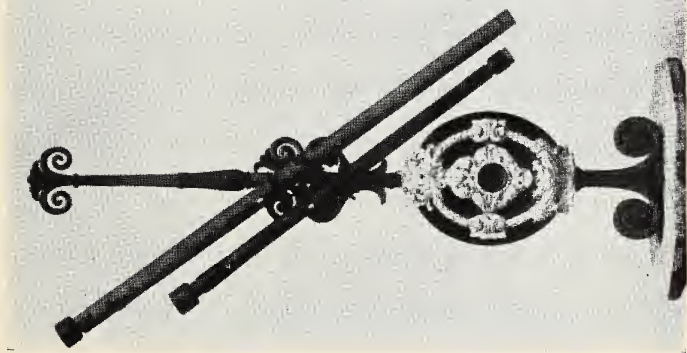
*The distinction and the pre-eminence
Of stuffs white, dark, or Persian-tinted,
Establishes the inequalities among the Christians.*

*Clothes and ideas which are alike
Are often the invention of the devil.*

*Have I the intention of wearing a robe
As though I were some Pharisee,
Or even scribe, or Rabbi?
Believe it not! I am no Hebrew;
Though by my name and that of my family
I might be judged descended from some Jew.*

*. To wear the robe!
The first punishment!
(Judge, and see its bearing!)
I am thus deterred from following my inspiration.
For instance, would I be happy with some girl,
I must perforce stop me at her door.
Another, unrestrained, can enter joyously.
'Tis said to be an error of grave consequence
For a doctor to commit himself to such things—
The weight of the robe will not permit it!*

*Should you go out on any business,
And pray it be completed before lunch,
Be sure it won't be ended before tea,
Because the robe will not let you move.
It twists about you, trips you, and annoys.
Walking is a battle without let.
It seems to me well suited only
To those who are in no haste to reach their goal;
To those who are not victims of fatigue,*



THE GREAT INVENTOR'S OWN TELESCOPES, LODESTONE AND COMPASS.

Whose maxim is—Be at your ease!

*These are the Congregational Brothers, or fat
priests*

Who merely leave their homes to stroll about

Or, as the saying goes, to gather mushrooms.

These go calmly, step by step.

The long robes suit them well,

But are not for such as I who

Must often run before the sheriff and the dun;

Who fear eternally reproaches from the Rector.

So, rather than be burdened with this robe,

I foist my lecture on to Messer Piero,

Or if he will not have it, Messer Giovanni.

These versifications, although inoffensive in themselves, were hardly a means of reconciliation with his colleagues or his superiors, many of whom belonged to religious orders.

His lessons proceeded with great élan. Listeners poured in. They were both hostile and sympathetic, but in any case they were attracted by the hope of the unexpected. What gave him the greatest courage was to know himself agreeable to the Cardinal Francesco del Monte, and the Grand Duke Ferdinand of Florence.

However, there was one professor at the Faculty of Arts with whom Galileo made friends immediately. This was Jacob Mazzoni. He was a freethinker, and his interpretations of Aristotle were not always orthodox either.

With delightful simplicity Galileo would attend his colleague's lectures and admit that he learnt a lot from them. They became very good friends, and most

of their leisure was spent in long conversations about complex problems.

Mazzoni had neither the force nor the audacity of a Galileo, but he was a wise counsellor. He encouraged Galileo in his researches and gave him confidence and hope in the midst of the general hostilities.

Shortly after these events an incident occurred which forced Galileo to leave Pisa. Prince Don Giovanni de' Medici, the bastard brother of the Grand Duke Ferdinand, fancied himself as an artist and a scientist. He invented a hydraulic machine which was designed to empty and clean the neighboring port of Leghorn. Before putting the machine and the project into action the Grand Duke ordered Galileo to examine the plans.

After a thorough investigation Galileo sent in an unfavorable report. As constructed at present, he said, the machine would be unable to serve its destined purpose; it would be a waste of time and money.

Galileo's calculations were accurate. But Prince Giovanni held it to be a personal affront and took the matter up with the scientists of Pisa. The fight became too one-sided and Galileo realized that it would be dangerous from now on to lecture in so threatening an atmosphere.

In any case he saw no hope of advancement in Pisa. More strings must be pulled. Giuseppe Moleti, his former correspondent and a professor of mathematics at Padua, had been dead for a year, and his chair had remained vacant. Now that Galileo had had some experience might he not hope for this post?

He had the misfortune to lose his father in July, 1591, shortly after his return to Florence. Confronted by the loss of those who are dearest to you, material

sorrows seem very minor. Why fight and hope when death threatens daily? Galileo went through those hours of terrible discouragement when the presence of death reduces everything to mere nothingness.

But life soon gripped him again. He urged the marriage of Virginia, his sister, to Benedetto Landucci, to whom she had been engaged for some time. He brought some silken bed-draperies with him from Pisa which he had bought at Lucca for a wedding present. They were of the finest silk. He had paid a good deal for them. They proved to be too narrow. He had to buy fringes to give them more breadth. He also hoped to buy all her linen for her.

Preoccupations of this sort, worries about cash for actual living expenses, and above all the peremptory need of finding an outlet for his genius, soon counteracted the depression caused by his contact with death.

On February twenty-first, 1592, Guidubaldo del Monte, his faithful friend and protector, invited him to spend a few days in Venice. It would be wiser for him to be on the spot in order to contend for the vacant chair at Padua, since the nomination must be made by the Venetian Senate. He himself was doing all he could to facilitate matters.

But Galileo was unable to get away before September of the same year.

He found plenty of favorable influence at Venice, people who desired his nomination and seconded him effectively. But what ultimately decided the Council of Public Instruction was Galileo's statement that rather than be given the post by favor, he preferred to compete and win it on his merits.

Finally, in a decree issued on September twenty-fourth, 1592, the Doge of Venice wrote to the Rectors

at Padua that in consequence of the importance of mathematics in its application to other sciences it had been difficult to discover a worthy successor to Moleti. At last, however, one had been found. The chair of mathematics vacant since the death of Moleti would from then on be occupied by professor Galileo Galilei.

Galileo was filled with joy. Here were significant words.

Importance of mathematics! Worthy successor to Moleti! Besides that, instead of sixty florins, he was to receive a hundred and eighty. Three times as much as before!

Luck had changed. His first contact with Venice seemed fraught with good hope.

BOOK TWO

THE FRUITFUL YEARS

Chapter VI

THE SALON OF ANDREA MOROSINI

ON HIS arrival at Venice Galileo was hospitably received by Giovanni Uguccione, the representative of the Grand Duke of Florence. Through him he was introduced into the famous gatherings at Andrea Morosini's house.

The Venetian patricians consecrated themselves almost entirely to public life, and subordinated everything else to the affairs and well-being of the State. They were not allowed to aspire to university positions, in order that they might devote themselves exclusively to their magistrature; but this did not prevent them from cultivating the Muses.

On the Grand Canal, near the quarter of S. Lucca, near the present municipal buildings, Andrea Morosini, who later was elected historiograph of the Venetian Republic, had his palace. It was the refuge of literature and erudition; a true temple of all the arts and graces.

Everything in this marvelous palace was a feast for the eyes. The decorations of the rooms, as well as the exterior architecture, had their peculiar style—the happy mixture of Byzantine and Gothic which is so characteristic of Venetian buildings. The rooms themselves were furnished with great taste, and were adapted to grand receptions, balls and banquets. An atmosphere of intimacy was perhaps lacking, but great

richness, works of art, all the brilliance imaginable, were not overwhelming in this vast setting.

The carved doors, decorated with bronze figures by great artists, gave access to the spacious entrance hall, which was entirely furnished with armor, its dominant beauty being the magnificent ceiling and a well whose bas-reliefs were masterpieces of grace. The salons were lighted by immense bay-windows through which the daylight poured. The polished floors, the ceilings painted in gold and blue, the sculptured walls, the marble mantelpieces holding candelabra of bronze or silver, the red of the draperies and the tapestries, the furniture which was both noble and graceful, and the vast coffers decorated with bronze and gold, were the eternal marvel of all who visited this palace.

All true lovers of literature, not only noblemen but both the religious brotherhood and laymen, were admitted to this circle on the recommendation of a habitué. Doges and senators, historians and philosophers, savants and *litterati* met there. The most erudite, whether inhabitants of Venice or birds of passage, were proud to be seen within its famous walls.

Fra Fulgenzio Micanzio, a learned priest who frequented these reunions, writes that the most diverse subjects were discussed there with the utmost simplicity. Ceremony was discarded. All the affectations which warp the spirit, all the lies and vain oratorical procedures so dear to the scholastic mind of the epoch were instinctively dropped. Conversation was free and unacademic. Anybody could introduce a subject which pleased him on condition that he could uphold and develop it in due order. The atmosphere was dominated by good faith and sincere desire for truth.

It was probably here that Galileo met Paolo Sarpi,

whose science has been called universal. Paolo Sarpi was the ultimate champion of Venetian liberty. Though a priest and a believer, he fearlessly opposed himself to popery and even risked excommunication. In this he was eminently Venetian. Venice was Catholic and did not favor heresy, but at the same time it did not admit the interference of the Pope in its affairs. Pride in its independence dominated its obedience to the church. For years this spirit had been the basis of misunderstandings with Rome. When speaking to the Venetian ambassador, Leonardo Donato, regarding these dissensions, the Cardinal Borghese is reported to have said: "If I were the Pope I would excommunicate all Venetians." "And I," replied Donato, "if I were the Doge, I should laugh at your excommunications."

Well, Borghese became Pope Paul V, and Donato became Doge, and they both kept their word. The promised interdiction was pronounced by Paul V in 1606 under the pretext that two priests, found guilty of infraction of some common rule, were to be judged by the Venetian government according to the laws at that time governing the State, whereas the Pope had demanded that they be brought before the Ecclesiastical Tribunal.

Obviously Venice did not particularly relish this collective excommunication, not wishing to bring about a definite schism. But it stood firm and would not give in. The order was given that all churches must leave their doors open as in the olden days, and all priests who refused to submit to this order were expelled.

Paolo Sarpi seized this opportunity. He made a public declaration that in all temporal affairs the

State would recognize no other authority than its own, and that as one of the leaders of the cult, he from thenceforth would take sides definitely against the Pope.

On another occasion, when summoned by the Tribunal of the Inquisition, he refused to go to Rome, considering that only the institutions of his own country had the right of judgment over him. Later he wrote a history of the Council of Thirty. His object was to expose the true facts. His condemnation of this Council was sweeping.

Unfortunately nothing is left us of Sarpi's scientific activities. His writings were lost to the world when his monastery burnt down. But his letters show deep interest in physical science, mathematics and astronomy, as well as theology, philosophy and history.

Galileo called Sarpi his master, so great was his respect and admiration for him. Fra Fulgenzio, his collaborator and inseparable friend, wrote the life of Paolo Sarpi in terms of profound devotion.

In Morosini's salon Galileo also met Giovanfrancesco Sagredo, another great personality. This Venetian ambassador had travelled widely in the Orient, and had brought back a mass of valuable social and physical data. He gave Galileo data of the greatest importance to the latter's study of magnets and thermometers. Galileo had no more devoted friend than this man. Sagredo never counted the cost, never tired. He put himself out, went to the utmost trouble and, in order to benefit to the uttermost by Galileo's society, even invited the scientist to his country house in order to surround him with the best possible conditions for the creative work he so deeply appreciated.

These were but a few of the many fine men with whom Galileo came into contact at Morosini's receptions. He met senators, councilors, cardinals, and other illustrious characters, many of whom played a part in Galileo's tragedy.

Chapter VII

THE CENTRE OF THE WORLD

THERE was a house in Padua which was comparable with that of Morosini in Venice. It belonged to Giovan Vincenzo Pinelli. All the celebrities of the epoch met there—savants, princes and cardinals. The university professors, accompanied by their best disciples, came there to finish their disputes. Musical sessions alternated with the most abstract arguments. Pinelli himself played the lyre; and Galileo, who assiduously frequented this famous *milieu*, accompanied him on his theorbo. Those who wished to follow the literary movement, acquire the latest knowledge, and taste the utmost joys of intelligent intercourse all took part in these reunions of cultured, enthusiastic minds.

Pinelli was a Genoese nobleman. Up to that time he had lived in Naples with his family. He arrived in Padua at the age of twenty-three in 1558, attracted by the unique reputation of its university. He settled there permanently and continued his studies and research work. He had a vast knowledge of Greek and Latin, and was well versed in all the arts and sciences. He was enormously rich, and he spent most of his money on rare books and manuscripts, encouraging men of worth by every means in his power.

He had the gift of discovering genius, and the additional merit of knowing how to develop it. He created an atmosphere of esteem, affection and emu-

lation around men of talent. He lent them whatever accessories they needed in their work. His library was one of the most comprehensive in Europe. Three ships were needed to transport it from Venice when he died.

Paolo Gualdi, who wrote a life of Pinelli, having known him intimately, reports the unfortunate loss of part of this library. During the transfer to Naples pirates captured one of the boats and several cases of prints and manuscripts were sunk.

Pinelli was the perfect type of *littérateur* of the Renaissance. He died in 1601. His friends mourned his irreparable loss for many years.

Galileo spent the first months of his stay at Padua in this house. Pinelli wished to spare him all the worries of setting up a home at the moment when his *protégé* needed all his time and peace of mind for the preparation of his opening lecture.

When a new professor made his initial appearance, not only pupils came to listen, but teachers, friends and superiors. Galileo wished this introductory lecture to establish a standard once and for all for a chair which had remained vacant for two years because no holder had been found worthy of it.

As usual there were prophets of good and evil. But the prophets of good were right for once. Galileo's first lecture on December seventh, 1592, caused an ovation. On all sides there were echoes of this triumph. Benedetto Zorzi, the Venetian senator patrician who had already sought Galileo out when he was teaching at Pisa, congratulated him warmly on his excellent *début* and prayed that his success might continue throughout his career.

Guidubaldo del Monte, to whom Galileo practically owed his new position, hoped that this beginning, so

full of promise, might inaugurate an era of prosperity for mathematics, a subject which had been so generally ignored or misunderstood.

Antonio Bissaro, another good friend, was delighted with Galileo, and sincerely believed that the chair at Padua was worthier than any other of the valuable services of such a master. And Girolamo Mercuriale, a celebrated doctor and professor at Pisa, reminded Galileo that he too had said that the university at Padua was the most appropriate setting for his genius.

During the many years of his stay at Padua Galileo's chief subjects were geometry and the sphere. In order to enter fully into the drama of his life it is necessary to realize just what the people of this epoch imagined the world to be.

The universe was represented as a series of interlocked spheres. At the apex was the immutable empyrean, or high heaven. Then came the crystalline spheres of the fixed stars and the planets. The stars were placed here and there like precious stones in these immense and transparent globes. In the centre of the universe was our world. All the celestial spheres revolved around the world in twenty-four hours; and man, for whom all this had been created, accepted this homage with complacent pride.

Surely the universe could not be as simple as all that. Though the stars might seem to revolve around the earth, there must be certain among them which had peculiar movements which, while following the general trend, gave them individual orbits. These were Saturn, Jupiter, Mars, the Sun, Venus, Mercury and the Moon, indiscriminately designated as "planets," which signified at that time "wandering stars."

But these orbits themselves were not regular, and

when trying to explain the system of the universe, it was necessary to take all these deviations into consideration. The ingenuity of the professors was severely taxed when asked for explanations. For two thousand years, since Aristotle and Ptolemy, tradition had been satisfied with this complicated illustration of the heavens.

Undoubtedly, even before Aristotle, thinkers had guessed at the movement of the earth, and consequently at the reversal of the rôles, though nobody had taken this chimera seriously.

But a certain Polish monk, Copernicus, former pupil of the university at Padua, had his suspicions. The accepted picture of the heavens was much too involved. He was convinced that Nature was essentially simple. If the mobility of the earth were to be accepted as a hypothesis, then what would actually happen? Apparently nothing! The sun and the stars would continue to rise and set. The seasons would remain the same whether the sun revolved round the earth, or the earth round the sun. The advantage in the belief of the rotation of the earth on its own axis in twenty-four hours, and around the sun in a year, was that it simplified the picture of the universe, minimised the anomalies and covered all data, ancient and modern, without the help of explanations which were too ingenious and subtle to be convincing.

This conception was certainly worthy of the astronomers' attention. But Copernicus' book, *De Revolutionibus Orbium Coelestium*, published in 1543, left the public quite cold. The preface, written by a friend who meant well but only succeeded in doing more harm than good, stated that the doctrine in question

was a simple mathematical supposition which did not pretend to convey the reality of things.

People laughed heartily at this amusing cosmology, and drew from it great inspiration for their carnival costumes. Copernicus died a few days after the publication of the book, and never knew the general derision with which his work was received.

For a long time there was utter silence on the subject of the new astronomy. One man alone carried on his propaganda for ten years, from 1582 till 1592, undeterred by ridicule. This was Giordano Bruno, the greatest philosopher of the Italian Renaissance. Galileo never met him, he never alluded to him in his writings; nevertheless he was deeply influenced by him. He heard Bruno referred to. Morosini had often received him. The great libraries knew of him and sold his books in Venice.

For long years Giordano Bruno had wandered outside his beloved Italy, because his ideas were under suspicion and he knew that the Inquisition was after him. He had lived in Switzerland, France, England and Germany, fighting with all his might against old-fashioned methods of instruction. He brought the Copernicus system, hitherto ignored or mistrusted, to their notice. He showed them the scientific and philosophical consequences arising out of that system, explaining that the earth was not the centre of the universe and stationary, as was believed, but a little planet like the others, revolving around the sun; that the sun itself was a star; that every star was the centre of a planetary system, and that there were innumerable worlds, each independent and probably inhabited just like our earth.

He stated definitely that the Bible had no right to

intervene in questions of Nature because the mission of the Holy Scriptures was to show us the path of salvation and teach us clean morals, but not scientific knowledge.

He went even further than his pioneer, broke up the rigid spheres of crystal which sustained the stars, swore to the plurality of the worlds, and cast into the domain of chimera the traditional distinction between earth and sky. He asserted that the universe was one and infinite, and that God, the prime mover, came from within and was immanent to this universe.

While Giordano Bruno was living at Frankfort-on-the-Main in Germany, a Venetian nobleman, a certain Giovanni Mocenigo, invited him to come and stay at his palace in Venice. He assured him that there he had nothing to fear from the Inquisition, and only asked him for a few lessons in exchange for his hospitality.

Knowing the independence of Venice and longing to revisit his own country, Bruno let himself be tempted, feeling sure of his safety under the protection of this patrician. After having profited to the utmost from Bruno's wisdom, Mocenigo treacherously denounced him to the Inquisition, because of scruples of conscience, he said, and by his confessor's advice.

Bruno languished for four months in the dungeons of the Holy See. Although the State of Venice announced its intention of saving him, it could not refuse his extradition on the demand of Pope Clement VIII, because Giordano Bruno was not a subject and therefore Venice had no rights over him. After eight years of prison and torture he was burnt alive on the famous Campo dei Fiori in Rome.

No doubt Galileo pondered this example and realised that in order to lay the foundations of science it

was unwise to make a frontal attack on the ecclesiastical authorities; better far to accumulate proofs and undeniable arguments which would stand on their own merits and force the theologians to adopt them in their interpretations of both the Old and New Testament. What was the use of suffering in prison and dying at the stake if no object had been gained, no triumph obtained? Better far to keep a discreet silence in questions which would compromise his existence until he was in a position to offer experimental demonstrations, and bring the church into line without direct attack. Why make himself conspicuous and bring discredit on his ideas, and merely appear ridiculous in the eyes of posterity? Galileo must have reasoned it out in his own mind. In any case, these were the tactics that he adopted during his occupation of the chair at Padua of which he took possession December first, 1592.

In his heart Galileo shared Bruno's opinions, but only his most intimate friends knew it. In his public lectures he still taught the old-fashioned astronomy, though he scorned it. Galileo may seem to have been lacking in courage and not to have had the moral strength of his predecessor. There is no doubt about the fact that the ridicule with which Copernicus' ideas had been received, and the terrible epilogue of Bruno's death, played their part in Galileo's attitude—but it must be known to what extent in order not to condemn him as a coward. He was anything but that.

Before Galileo, philosophers had proclaimed as living truths laws which were based purely on intuition, without bothering about rigorous experimental demonstrations. No doubt Bruno had been right, but what he stated as absolute fact was only a hypothesis in Galileo's eyes; a very probable one, but a hypothesis

just the same, which needed to be justified by experiment.

Galileo wanted to prove his statements before entering into battle. Perhaps the word "battle" is hardly correct. He thought he only had to present the facts and demonstrate the conditions under which they had been proven, and they would be accepted.

Galileo was no poet drunk with his own imagination, carried away by the force of his convictions. He cut himself off completely from the intellectual adventurers of earlier centuries. He was the first great scientist of the new era.

Galileo also deplored the intrusion of the church into the profane realm of science, and realized all the danger of this social order; but it was too early to uphold Copernicus publicly. He had to be content to adhere to his teachings in his innermost soul, and it was only to Kepler, the great astronomer of Emperor Rudolph II of Germany, that he dared communicate his utter faith.

Chapter VIII

THE HOUSE OF THE OX AND THE INTRIGUES OF THE JESUITS

IN THE neighborhood of the street called San Biagio, there was in Padua the equivalent of the Latin quarter in Paris. It, too, was the student quarter, and pupils and professors alike lodged near their schools.

The different groups assembled in a magnificent hostel "At the Sign of the Ox," probably thus designated because it occupied the site of former stables. Its name, "Cà del Bo," figured even on public deeds and persisted in spite of the efforts of the rectors to change it to the more appropriate name of "Sapientia." Words, like rituals, survive their early uses, and the Ancients of Padua, even to-day, talk perfectly seriously about The House of the Ox when designating the house of learning. In any case, the three doors still bear the incredible names of the Ox, the Cow, and the Calf.

One of the towers of this building was converted into a belfry. The bell which summoned students to their lectures was also timekeeper for the whole countryside. It was the symbol of work and regularity, the distinctive emblem, the pride of the university.

In Padua the greatest tolerance was shown to heretic strangers who came there to study. So long as they made no mischief they were free to practise their religion. The Venetian Republic was the great excep-

tion to contemporary bigotry. It alone remained faithful to the principles of the separation of things temporal and things spiritual.

That is why the Government took the part of some German students against the Bishop of Padua when the latter made himself offensive to them. This defiance to the church stimulated the sacred zeal of the Jesuit Fathers who were establishing themselves at Padua at the moment of Galileo's inauguration. They benefited by the same tolerance. Their object was to insinuate themselves into souls and endeavour to substitute their college for the celebrated secular university.

"These fathers," said a responsible witness, "arrived upon the scene poverty-stricken. Their attitude was humble. They started by teaching grammar to children, and then gradually they managed to accumulate riches—heaven knows how! They succeeded in getting a foothold everywhere. They taught all the sciences, with the firm intention, I believe, of making themselves heads of learning at Padua, though even that might not suffice to gratify their overweening ambition. In the name of God and religion they started a most insidious rivalry. Thanks to their institutions which were spread throughout all Europe, they discredited the University of Padua and tried to make it known as the centre of heresy, of perdition and of every form of vice. Becoming bolder, they published under the title of The Paduan School of the Society of Jesus a schedule of studies. They posted this in all popular centres and in the libraries, and made out their order of lectures in exactly the same manner as the University. Finally overstepping the bounds of insolence, they too announced the hours of their classes

with a tolling bell; thus daring to profane in the very precincts of the University the symbol that had been its mark of distinction."

The jealousy became more and more bitter. Two enemy clans were formed—the Bovists, students of the House of the Ox, and the Jesuits, students of the establishment across the way. The entrance of a Bovist in one of the Jesuit schools, or vice versa, meant trouble and rioting in the lecture halls—quarrels which overflowed into the public squares. Mutual insults were scribbled on the walls and above the professorial chairs. There were daily battles which often terminated in bloodshed.

The rules of the University did not allow the professors to dictate their lectures, but insisted on their being extempore, in order to stimulate the spirit of discussion and also to prevent loss of time and mental inertia among the auditors. The Jesuits, on the contrary, in order to attract a following and encourage mental laziness, adopted dictation; thus the rich could avoid attending the lectures, and often sent their servants in their place to jot down what the master had dictated. An ignorant professor, engaged because he was cheap, could even dictate a lecture by somebody else, thanks to the printed text which he had under his eyes. Such a professor became known as *doctus cum libro*.

These proceedings, as may well be imagined, were detrimental to the material prosperity of the University and the development of culture among the students. Then, as now, the justification of a chair was measured by its success and the size of its audience. It is easy to imagine the anxiety of the heads of the Faculty who saw themselves replaced by automatons.

In order to avenge them, some of their most faithful partisans played a diabolical trick on the reverend Fathers.

One fine spring day, some of the young patricians of Venice wrapped themselves in shrouds and wandered like ghosts through the streets of Padua. At the busiest hour in the College of the Company of Jesus, they forced an entrance into the main lecture hall and grouped themselves around the terrified lecturer. There, with the precision and seriousness of a practised rite, they let shrouds fall to their feet and appeared stark naked before the scandalized eyes of the public and the lecturer. This fooling caused a great sensation, and the rectors of Padua sent a report of it to the Council of Ten, who were the supreme governing power of Padua.

At the same time this council received an anonymous letter. This was a typical example of Jesuit procedure. In it a pretended patriot deplored the decadence of the university, its loose morals, its impiety and the disorders thereby provoked, and demanded severe measures for the protection of the interests and honor of the Republic. Greatly stirred, the Council of Ten made inquiries, and the young Venetians who had provoked the scandal were sent to prison.

At the opening of the session the University professors delegated Cremonino, professor of philosophy, to plead their cause before the Doge, and expose the danger run by the Faculty, thanks to the undesirable innovations inaugurated by the Jesuits, who had taken upon themselves the right to teach and give diplomas without the license of the Venetian Republic.

The Superior of the Jesuits, aware of their intentions, exhibited to the Governors of Padua a docu-

ment from Pope Paul V authorising them to teach and confer diplomas. In it the Pope threatened the Council with excommunication and the church's displeasure if it made any move against the Jesuits. But the University would not let itself be intimidated, and Cremonino proceeded to Venice to defend its cause.

At first the rectors at Padua tried to be tactful and make concessions to both rival institutions. They forbade the Jesuits to print and post programs of classes in the town and above all to toll their bell, as this was the dominating cause of all these quarrels. But to make up for this, they agreed to allow them to teach all subjects on condition that their hours did not conflict with those of the Faculty.

But the powers in Venice, jealous of its independence, saw provocation and triumph in the attitude of the Fathers and decided to put brakes on such abuse. They ordered the rectors of Padua themselves to summon the Jesuits before them and inform them that the Republic forbade them from then on to teach the higher subjects, since they had dared to inaugurate a form of study disapproved by the State, which prejudiced the Faculty and was derogatory to the University rules.

This was how Venice answered those who wished to involve its liberty. Menaces and excommunications could not intimidate it. It remained Catholic and true to the Faith, but firmly convinced that religious authority must lie in the spiritual domain and not insinuate itself into national questions.

The Jesuits, mortified by this affront, secretly swore vengeance. And, several weeks after their defeat, as though by chance, the rector Pietro Alzano, who had been the first to protest against their actions, was

treacherously assassinated in the public street by masked ruffians. By whom had they been hired?

Such was the state of affairs at Padua during Galileo's first years there. After this experience he felt no great esteem for the spirit of the Jesuits, despising their methods, which lacked honesty to say the least. Yet in the midst of all this confusion Galileo managed to map out and to prepare his lectures with great thoroughness, think out new problems and develop to the uttermost his personality and his genius.

Chapter IX

WAYS AND MEANS

PUBLIC lecturing was not Galileo's principal source of income. It would not have been sufficient for his personal needs, and it was certainly inadequate for the family burden which he bore entirely on his own shoulders. Private teaching paid him best.

It was an old custom in Padua for the professors to give private lessons, apart from their public lectures. In fact the Venetian government not only expected, but even ordered them to do so. While attending the lectures at the University, the students chose a master in order to perfect themselves in subjects that interested them most. Many, in fact, came from far off countries and contented themselves with this form of instruction without even inscribing themselves in the registries of the Academy, preferring to be called the disciple of some famous master rather than have any official title.

This teaching was fairly lucrative, and when they saw the chance some of the pupils practised it themselves before they had even obtained their diplomas. They sometimes established themselves in Padua with this object in view.

Quite soon after his arrival, Galileo had several private pupils. Some of his subjects were not part of the curriculum of the Faculty of Arts. He taught military architecture to princes and nobles who wished to learn

methods of defence and attack. This course was particularly successful among those who either intended to become soldiers or were destined by birth to rule their country. Besides teaching the art of fortification, he gave lessons on mechanics, about which he wrote a vast work. In it, thanks to his experiments and calculations, he developed and clarified the rather vague conjectures of Guidubaldo del Monte, his master and his great friend.

Galileo had just invented a compass especially constructed with four branches, each graduated, which served to divide lines in equal parts, to change the scale of figures and to determine the relationship of equivalent bodies. This instrument interested the studios, but its use involved technical instruction. So amateurs came in numbers to Galileo to learn the various methods of handling it.

The custom of private tuition established a close contact between the professors and their pupils. But another custom which created even greater intimacy between them was that of having pupils who boarded in and who were preparing themselves not only for the winning of various diplomas, but for intensive general culture. When they happened to belong to the nobility, students of this category came to their chosen masters with one, two or even three servants. The intimate conversation at meal-times, enlivened by exchange of ideas and discussions under the professor's direction, undoubtedly made a deep and lasting impression on these young and eager spirits.

Cardinal Bentivoglio, speaking of Riccoboni, a colleague of Galileo's, says in his *Memoirs*: "He used to gather young people around him. My own relatives thought it seemly that I should live with him a couple

of years to reap the harvest of his private teachings, which was more comprehensive than that which I should have gained by frequenting public lectures with other pupils."

Count Montalbano, accompanied by two personal valets, lived with Galileo for nearly seven years. He paid 240 lira a month, which at that time was an impressive outlay, but he did not leave until he had received his doctor's degree.

Besides his pupils and their servants, his friends and his own servants, Galileo also housed a certain Marcantonio Mazzolini, the workman who made his compasses, as well as the latter's wife and daughter. Imagine the size of the house necessary to this humble university professor and the difficulties of organizing it. It is hard to see how Galileo ever managed to find time to himself in this turmoil. He personally kept track of the accounts of his boarders and externes, the catering expenses, the cost of materials bought by the workmen, the bills of clients and friends who ordered instruments, the expenses of his family in Florence, and his debts to the university. For he was always short of money.

He entered all incoming and outgoing monies meticulously. On the fifth of July, 1596, he had to pay six ducats to his workman for the year. On July eighth, Giovanni Tenim bought a compass for thirty-five lira. On the seventeenth, Benedetto Tiepolo, a four-point compass, forty-two lira. August eighth, Guido Bentioglio, the same article, forty-nine lira.

Galileo certainly had a great deal to do from an administrative point of view. It is difficult to understand how a man with his meagre resources was able to instal such an establishment. But he had many friends

among the rich Venetians, and they came discreetly to his aid. Pinelli, ever generous, probably gave him furniture. Zorzi, who had a palace at Padua although his business was in Venice, wrote telling him to count on his aid. "Use whatever you need of my goods. Whatever you may want you have only to tell my major-domo, who knows how much I wish to serve you and help you."

The abbot of the San Giustina monastery gave him chairs, beds and utensils; and when Galileo entertained people of note, the thoughtful monk gladly lent him the necessary linen and china. He even received the King of Sweden into this haphazard establishment. During the months of his stay at Padua the King never missed one of Galileo's lectures.

In June, 1596, Galileo received an invitation from Verona to come and teach the daughter of an illustrious Marquis during his holidays; but his work would not permit him to undertake a journey which meant at least half a day on horseback.

At this same period Guidubaldo del Monte, his devoted protector, particularly recommended his son to him. He begged that the boy, who came to Padua in 1597, be taken under Galileo's personal direction and taught to love mathematics.

Galileo undoubtedly had too much to do. But although his multitudinous occupations may have interfered somewhat with his personal work, the self-discipline this sort of living entailed developed characteristics which stood him in good stead throughout his life.

Galileo's fame grew daily. Celebrated people asked to be allowed to meet him, attracted by the prestige of his inventions, the original turn of his mind, and his

marvelous capacity for drawing unsuspected conclusions from the most humdrum happenings of daily life. Unlike most of his scholastic contemporaries, his talk was never meaningless. His statements were always backed by proven facts. His reasoning had a concrete point of departure. He did not lose himself in vain imaginings, neither was he dogmatic. He always admitted that he might be mistaken, and he knew how to draw a clear line between hypothesis and certainties.

Clear-sighted men of the Renaissance recognised a leader in him. They felt that he differed from other men of letters. He gave the world a new method of questioning Nature and a new language in which to interpret the answers. Above all, he introduced a fundamental separation between philosophy and science, which had always been confounded. And he maintained that only syllogisms could resolve the question of experiments by which reason and observation must prevail against the pretensions of philosophers who did not give a hang for the outside world.

Chapter X

HOME LIFE

IN ADDITION to all this work, Galileo not only had to meet his family's expenses, but bear all their troubles too. Hardly had he settled in Padua when letters from his mother and brother began to pour in, full of depressing domestic problems and a million and one demands.

For instance, in order to facilitate his sister Virginia's marriage, he had promised her a dowry which he had hoped to pay out of his salary. But the drain on his income was so great that he could not always meet this obligation. It was a constant source of trouble. Galileo longed for the first holidays in order to find rest and mental peace. Being only human he hoped to reap a little of the harvest of his success in his immediate family circle. But his mother wrote warning him that he had better act discreetly, as things were going far from well in Florence. For his brother-in-law was implacable. He demanded the dowry immediately. He even threatened to have Galileo arrested, and he was a man quite capable of carrying out his threat. This was all Galileo had to look forward to in the way of a holiday after his first year of infinite labor.

The ensuing years were no better. Galileo was constantly driven to beg advances or a raise in salary. His friends interceded for him at the Senate. His one

hundred and eighty florins a year were not enough. He needed three hundred and fifty. His friend Quirini did the best he could for him. He obtained the intervention of the procurator Donato, one of the reformators, who only objected because of the meagre contents of the university cash-box. He added that it would create a bad precedent to double a salary which had only just been raised.

Sagredo, always loyal, went to the other two reformators. The first of these, Contarini, showed little inclination to vote in favor of it. But the second, Matteo Zane, spoke with great admiration of Galileo's lectures, and his only objection was that Moleti, his famous predecessor, had never received more than three hundred florins.

At last, on October twenty-eighth, 1599, the Venetian senate voted by a large majority for the renewal of the contract and an increase of a hundred and forty florins, justifying this decision by the prestige which the lectures on mathematics had acquired, thanks to Galileo.

This sum was not great when unforeseen events and illnesses are taken into consideration. For instance, Galileo spent several days at Sagredo's villa in the country. One night he slept by an open window which gave out onto a lake and a fountain. Next day he found himself crippled by a severe attack of rheumatism of which he could never quite rid himself and which troubled him all his life.

One of his colleagues, Acquapendente, a professor of medicine, prescribed him pills of aloes. In order to economize, Galileo prepared the pills himself according to the doctor's prescription. He bought some aloes which he carefully pounded after having eliminated all

impurities, and then exposed them to the sun soaked in essence of roses. The remedy can hardly be called efficacious, since the sick man never got rid of his aches and pains. But that did not lessen his confidence in the famous pills which cost him so dear.

Galileo probably agreed with Cicero's famous maxim that a man cannot devote himself to both a wife and a philosophy, for he never married. But he was greatly attracted by the famous courtesans of Venice.

These women's charms were so well considered that princes and cardinals celebrated them without considering their own honor diminished. They were not vulgar money-seekers, but "honored ladies," as the expression went. They knew all the refinements of love. Painters depict them in modest and discreet attitudes, arrayed in gowns that were sometimes eccentric but none the less seductive, and always in good taste. They were cultured and knew how to make conversation and interest those who frequented them; so much so that the men who visited them did not seek animal satisfaction only. These women loved music and created admiration for it among those around them. They were received at the fêtes and banquets of the patricians and introduced to their families and friends. The annals of that epoch show that the courtesans took far better care of their bodies than the great ladies. In their bath water they used scented plants which left a delicate odor on their skin. Slaves poured aromatic oils on their hair, polished their nails and surrounded them with every attention.

Letters from their lovers reveal an astonishing attitude towards them. They were as respectful and chaste as a letter to a fiancée. For example: "I kiss your

hand, your hand so honored and virtuous, gentle and courteous."

Ever sensitive to line, colour and beauty in all its forms, Galileo did not disdain the favors of willing beauties; but his time was so taken up by his occupations at Padua that he was regretfully forced to give up these alluring incidents and content himself with one mistress, a Venetian named Marina Gamba.

She lived with him, but she seems to have made little impression on his inner life. She had a child by him. The baptismal record reads: "Virginia, daughter of Marina of Venice, born of fornication thirteenth August, 1600, and baptised by Gio. Viola at the church of S. Laurent."

All this meant fresh expense in addition to the fact that he found himself involved in the futures of his brother Michaelangelo and his sister Livia. His brother received an offer to enter the service of a grand Polish nobleman, who offered him a home, fine clothes, two personal valets, a carriage with four horses, and three hundred écus a year. An extremely desirable situation, Michaelangelo said. He probably exaggerated.

But he needed a thousand and one things for his trip, to say nothing of his fare. Would Galileo please advance him at least two hundred écus?

Galileo's pay for a whole year at the university did not amount to that much. But he did not want his brother to miss such an opportunity, so he contracted fresh debts to help him. Of course it was understood that Michaelangelo was to pay him back out of his first year's salary. In the meantime, off he went.

While Galileo was fighting to find the necessary money for his brother's adventure, his sister Livia was developing violent passions. She was boarding at a

convent. But the cloister made her melancholy. Her desire for married life was imperious, and she dreamed incessantly of a certain Pompeo Baldi, who had succeeded in conveying his passion for her over the convent walls. It did Galileo little good to write to his mother and explain that he was not in a position to give Livia a dowry. He pointed out that the pretender to her hand could not support a household. But Livia was obsessed and "determined to face the miseries of this world."

At last another suitor presented himself. This Taddeo Galetti was a better match, and Livia soon transferred her flame to him. They were married on January first, 1610. Galileo promised her a dowry of eighteen hundred écus, of which he paid six hundred in advance, having borrowed them on interest.

A few months later, in August, Marina bore him a second child, to whom he gave his sister Livia's name. All these successive demands were such a heavy drain on Galileo's budget that he was no longer able to satisfy his creditors. He had counted on his brother, but the latter showed no sign of life. Not a letter had arrived since his departure for Poland. No proof of any intention of recognizing his obligations. The situation seemed hopeless. Though Galileo wore himself out with work, he never managed to settle his debts.

In May, 1602, he was driven to the humiliating expedient of asking the reformators of the university to advance him two years' salary. The following years he had to borrow more. The State of Venice certainly showed great indulgence towards him.

These loans brought Galileo temporary relief, but the time soon came again when he found himself in even greater difficulties. He had to keep on putting off

payments, hoping against hope in the meantime to earn enough to clean up his debts.

All these family and financial troubles, and the illness which nagged at him, began to tell a little on his character, which was fundamentally cheerful and trusting. He had a robust constitution which enabled him to stand superhuman fatigue; but sometimes he showed symptoms of nervous impatience and suffered periods of depression. This was natural considering the incessant annoyances of his daily life and his arthritic pains which were persistent and sometimes quite violent, forcing him to take care of his body and sacrifice precious hours to it.

Chapter XI

THE LEISURE HOURS OF A PHILOSOPHER

GALILEO'S life was not limited to his lectures, his private lessons, the administration of his home, or to his domestic troubles. His personal studies were extensive and varied. He was not content with mere theories. At Pisa he had applied the laws of the pendulum to medicine and to the measure of astronomical time. The first year at Padua he took advantage of his spare hours to enter the realm of mechanics and construct a machine capable of raising water and destined to irrigate the soil.

In those days people made no bones about self-praise. In December 1593 Galileo asked for the patent of the Government of Venice in these terms:—

“To His Most Serene Highness and Very Illustrious Seigneur: I have invented a machine to raise water and irrigate the soil. It is easy to handle, costs little, and is very practical, being capable, with the use of a single horse, of putting into action twenty outlets of water simultaneously.

“I should like to use it now, but fearing lest this invention, which is my own property and has cost me much money and fatigue, fall into common use, I humbly beg Your Serenity to deign to favor me with the concession that you accord in like cases to intellectuals of my profession, and

agree that nobody but myself and my descendants may make the said machine."

The patent was accorded for twenty years, but there is no trace of the ultimate fate of this invention. On application it probably did not realize the hopes of its inventor, who was not the first to have his expense and trouble for nothing.

Galileo continued to frequent Pinelli's house after he moved into his own home. Antonio Querengo's house was another refuge of the same sort. Paolo Gualdo, the vicar-general of the diocese of Padua and the touching biographer of Pinelli; Benetto Zorzi, Galileo's friend and admirer; Paolo Sarpi and Sagredo, whenever they happened to be on a visit to the town; Lorenzo Pignora, archeologist, Latinist and poet—could all be met there.

Vincenzo Contarini, who was a habitu  of this salon, writes: "Querengo's house, so frequented and so famous, was a very temple of erudition. A veritable oracle, Querengo knew how to answer all questions, not in a roundabout way, but clearly and without hesitation, so that those who consulted him could perceive his competence. The most admirable thing about him was that he did not excel in this or that particular art, but in all those which formed the background of a man of his standing."

This is not surprising. The great *literati* of the Renaissance were all alike in this respect: they had not yet been corrupted by the modern disease of specialisation. Their avidity for learning drove them to vast and profound culture. They were not all necessarily creators or inventors, but they cultivated every branch of learning with religious ardor, not merely

superficially, finding their objective and their joy in knowledge and understanding.

What were the topics of conversation in these literary salons? Everything! The latest books, the newest ideas, the most recent observations, anything that led to constructive thinking. To Galileo, who knew how to find significance in the least things, these gatherings were a constant mental stimulant.

One day in October, 1595, Galileo told them that he had seen himself in a dream on the burning remains of the cathedral of Pisa, and that he had had the strangest impressions and had suffered fearful agony. The dream was a fine subject for discussion in this centre devoted to intellectual speculation but completely free of vulgar superstition. A few days later a messenger arrived from Pisa. He announced that the Duomo had burnt down on that very date, and under conditions which recalled Galileo's dream. There must have been something astounding in this coincidence to these men who inherited the clouded beliefs of the past and who had barely crossed the threshold of modern science. It is easy to imagine the contradictory arguments which ensued.

It was during these reunions that a patrician, the future Cardinal Federico Cornaro, conceived the idea of founding an Academy destined to organize these philosophical discussions, and to leave a lasting trace of them. Having obtained the consent of several friends, he gathered them about him at his palace, now destroyed, situated at that time near the bridge of Santa Sophia.

Like all the wonderful palaces of Venice, it was a marvel. And in this glittering frame the reunions of the Academy of Ricovrati were held. It was so named

—the Academy of Refugees—at a preliminary seance on November twenty-fifth, 1599. Cesare Cremonino was a member as well as Galileo. The ninth of January 1600 was the date of the first meeting. The president, Federico Cornaro, “The Prince” as he was commonly called, repaired in great style to the church of San Antonio, followed by the members of the company, and had a solemn mass performed with music in the presence of Giovanni Cornaro and Antonio Priuli, one the Governor and the other the Captain of Padua.

Galileo was named censor. His duty consisted of reading books and giving an outline of them which permitted the Academy to speak of them with authority and without making erroneous statements.

Sessions such as those of the Academy were not the only ones. There were two libraries in Padua, Bolzetta and Tiozzi. These shops were situated under the Portici Alti. Nearly all the streets of Padua form arcades which protect the pavements from rain, so that it is possible to sit on the threshold of the shops without inconvenience.

These libraries were the informal rendezvous of the intelligentsia, and particularly the lecturers of the University. There the lists of classes were posted and all University manifestoes. It was there, too, that the professors discussed most questions and their solutions. At the time of the memorable quarrel between the Bovists and the Jesuits these libraries were undoubtedly hotbeds of agitation and intrigue.

Galileo naturally took part in all these more or less acrimonious discussions; but in peaceful times he consulted catalogues, kept in touch with all new publications and gathered information on the literary and scientific situation in other countries. For the librari-

ans travelled a great deal, attended all the fairs in the greater cities of Europe, always alert and interested. They gathered all the current literary gossip, and knew how to repeat it to their regular clients with wit and animation.

There was another rendezvous which Galileo frequented with all this erudite company, which was just as *recherché* and far more picturesque. This was the famous pharmacy at the Sign of the Angel. In the shadow of its doorway, seated on pitilessly hard benches like the disciples of Zeno before them, the professors gravely discussed myriad questions. Probably the pharmacist who presided at these learned gatherings, while concocting his pills and potions, occasionally made mistakes for which the sick paid dearly.

The intellectual cauldrons of this epoch were boiling over, and Galileo's activity in both his working and his leisure hours must have been phenomenal. He even found time for music. Galileo had a passion for composition. He knew how to read musical scores. He played the lute well and loved to charm his intimates. Apart from that, he corresponded with Sagredo, Guidubaldo del Monte and Paolo Sarpi, being unable to see them as often as he might have wished.

In December, 1602, the Ambassador of Venice left for London. Sagredo took advantage of the opportunity to write to William Gilbert, an Englishman who had just published an extraordinary work on "The Magnet" full of curious observations and original ideas. Sagredo asked Galileo to add a few words to the letter expressing his appreciation. Doubtless Galileo was only too glad to do so, recognising more

than anybody else the great worth of the English philosopher.

In August, 1602, Sagredo acquired a magnet in order to make personal experiments. He reported his results to Galileo and sent him the magnet.

What a strange thing a magnet is! Its action and its poles correspond to that of the earth in such a way that one of the poles is more efficacious in Padua than in Florence, and vice versa. The earth, too, is a vast magnet surrounded by invisible and mysterious forces. Sagredo's magnet was very powerful. It could lift a weight of six and a half pounds. Held at the point of a heavy sabre it could draw the weapon in any direction and force the hand of the man holding it to follow its movements.

Galileo observed another amazing characteristic. From the same side he could attract or repulse iron with the magnet. He attracted it when the magnet was held four or five inches away; he repulsed it when the space was only a finger's breadth.

Galileo succeeded in multiplying the power of the magnet by means of armatures and by winding steel threads around the poles. According to the disposition and quality of these threads the magnet's force varied. Finally he discovered the fact that the magnet raised two weights placed simultaneously at each pole far more easily than one single weight. It seemed to need the two objects to maintain its equilibrium.

Galileo wrote all these observations to Sagredo and Paolo Sarpi, who discussed and verified them with keen interest. In connection with the magnet, Sagredo had an experience which teaches a lesson forgotten again and again. An obscure scientist tried to sell him

the secret of how to converse at a distance by means of "the sympathy of magnetized needles." Believing the man to be a charlatan he ordered him off, saying that he had no intention of leaving for Cairo or Moscow in order to verify the experiment. Let the inventor go there himself and speak to him if he could! He preferred to stay at home and listen.

Speaking by means of "the sympathy of magnetised needles" is, after all, the basic principle of telegraphy and telephony. Who knows whether this poor devil, dismissed so summarily by Sagredo, in spite of his intelligence and culture, was not an unknown genius and the precursor of the discoveries which are the glory of our epoch?

In addition to the activities outlined above, Galileo continued his research on the oscillations of pendulums and tried to persuade his master, Guidubaldo del Monte, of their isochronism. It was not easy to convince the great mathematician, and Galileo needed all his tact and patience in order to prove to him the result of his experiments.

All his leisure, however, was not spent in so weighty a fashion. He was not averse to lighter forms of amusement. There were dinners and dances. Comedies were performed, and popular recitations given in public places. Serenades were also in vogue. Galileo himself wrote several burlesque comedies. He may even have played in them. This learned society, though learned, reveled in the intrigues of farces full of questionable situations.

These plays were enlivened by all the libertinage imaginable, and the most obvious complications. They were full of movement, but lacking in delicacy and

wit, invariably ending in a happy marriage. But the spectators, although cultured, did not seem to want anything better.

The most celebrated comedies of the Renaissance, *Mandrogora* of Michiavel, or *Grandelaio* by Bruno, for example, always showed a strong element of obscenity and coarse intrigue.

In May, 1604, when there was a question of Galileo going to Verona in the service of the Duke of Gonzaga, the sovereign asked him to perform a play of his at the court. The event never took place, but it shows that Galileo's plays were not unsuccessful.

Sometimes Galileo took part in traditional ceremonies. At the beginning of the term starting November first, the students elected two rectors of the university. These were gowned in scarlet togas trimmed with ermine. Followed by professors, students and others in their grandest robes, they appeared before the bishop and the magistrates of the city to whom they presented a gilded baton as a sign of obedience. In exchange they received the seal and the statutes of the university. They held the positions for a year, arbitrated differences between the students and busied themselves with the administration. Every candidate for doctorship gave them a gold florin, whereas they themselves were exonerated from paying any entrance fees if they desired to expound a thesis. They also received the insignia of a Knight of San Marco.

These rectors were chosen from among the student body. This admirable method was adopted by the Venetian legislature in order to make the students feel that they were actually part of the University, and to develop in them a sense of responsibility and initia-

tive. It would never enter their heads to recriminate against injustice or bad organisation, since they themselves had nominated the judge and the administrator. This election was made without distinction of nationality or even religion. In a Catholic country jealous of its independence and its authority, this measure was the ultimate proof of its magnificent tolerance. What Venice dared to do in the age of the Inquisition and the religious wars may well serve as an eternal example.

Under the protection of the winged lion of San Marco, the Venetian symbol of force and right, the boldest minds, the very heretics themselves, found liberty of speech in both Padua and Venice, and were allowed to discuss any subject without opposition. Never did the Inquisition erect a stake on this blessed soil. Students were particularly welcome. German Lutherans who dared not show their faces in Rome came in imposing numbers to Padua. No matter what their financial situation, they all managed to live there. The rich ones, accompanied by secretaries and a suite, occupied entire palaces. Those whose means were more modest, rented rooms or boarded with professors, and the really poor received free lodgings thanks to the subventions of the town and the State.

Venice was full of temptations, but the easy pleasures and artificial excitement which could be found in the company of the courtesans did not appear to conflict with the love of study.

What a country to live in! Galileo never forgot the years of happiness and liberty he had known there.

Just before his death, overwhelmed by every imaginable persecution and humiliation that can be inflicted on a great thinker, he wrote these touching words to

a friend: "It is not without envy that I learn of your return to Padua, where I spent the eighteen best years of my life. Enjoy to the utmost the liberty and friendships which I appreciated so deeply myself both at Padua and in the neighboring city of Venice."

Chapter XII

A SCANDAL IN THE HEAVENS

SUPERSTITION, magic, sorcery, mysterious practices which modified the natural course of events, consultations of the stars which determined destinies, philosophers' stones capable of turning all metals into gold, incantations and malefactions which reacted on human beings from a distance, oracles which foretold future happenings—all these superstitions mingled with the genuine desire for knowledge. They were not only prevalent among the populace, but even among the magistrates and the majority of the *literati*. The Senate actually consulted soothsayers before making important decisions. Galileo himself, the father of modern science, read his children's horoscope at their birth.

Astrology seriously interfered with astronomy. Anything could be foreseen and explained by the stars!

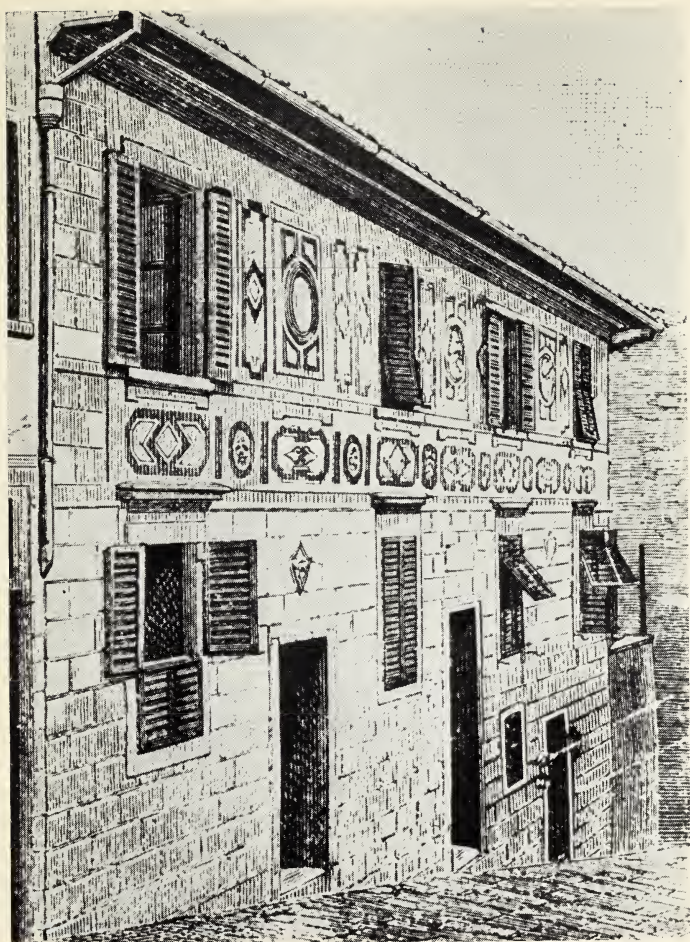
On an October day in 1604 the terrified populace of Padua perceived a strange light in the heavens. A new star, big as an orange; a sign from the Most High! Might it not be the very one that of old had led the Magi to the stable where God's Son was to be born? But what could be its actual meaning? Was it an omen of some public calamity? Some pitiless war? Or a devastating epidemic? Might it not foretell the universal punishment of the heresies which infested Eu-

rope? Or even the end of the world and the destruction of mankind under a rain of sulphur and fire?

Magicians and sorcerers were consulted on all sides. The oracles were pessimistic. The astrologers' almanacs made prognostications that nobody could understand, but which the people repeated under their breath as though fearing lest by raising their voices they might provoke the Divine anger.

Not only among the ignorant populace, but even in scholarly circles frequented by the disciples of Aristotle, the new apparition created panic. According to this incontestable master of all sciences, the heavenly galaxy which immediately preceded the House of God and the elect was immutable and unalterable. No anomaly could exist therein. The number of stars was exactly known and had not varied since their creation. They were counted on clear nights by celebrated astronomers gifted with excellent eyesight and accustomed to exploring the heavenly regions. It was conceded that the globes which supported the stars moved, but their movement was circular and perfect, as became heavenly beings. But there also existed the region which lay between the earth and the lunar sphere, the shadowland of death.

Although the Aristotelians saw a star born in the heavens and modified day by day under their very eyes, they still would not give in. It was no star since there was no record of it in the official catalogue. They denied its existence with irrefutable syllogisms. Degeneration and corruption only existed between contrasting things—life and death, height and depth, weight and lightness. As the circular movement, which was perfect, held no contrasts, the so-called star must be an illusion. The material elements could alter, because



THE HOME OF GALILEO ON THE VIA DELLA COSTA SAN
GIORGIO IN FLORENCE.

they came into contact with one another and blended, but the heavenly bodies, quintessential facts, were a different matter and could know no contamination. Consequently birth and variation were not possible in the heavens.

When doubters insisted that something resembling a star of extreme brilliance and of exceptional size was undoubtedly apparent, they were told that it might be the reflection of the sun, a sort of rainbow, but that in any case it could not possibly be in the sky itself, but must emanate from beneath the moon, whence came all corruption. Aristotle couldn't possibly be mistaken, since he had created the art of reasoning!

In order to uphold the theory of the celestial incorruptibility which was the keynote of their astronomy, fanatic monks maintained that God had just created the new star in order to remind sinners of His might.

Galileo was one of the first to observe the new star. In response to the general demand he gave three lectures on the burning subject which was impassioning public opinion.

This is about what he said:—To begin with, this apparition is not unique in history. Several years ago, in November, 1572, the Danish astronomer, Tycho Brahe, observed the same sort of star of which the intensity at moments was so great that it eclipsed all other stars and was even visible in full daylight. This one had appeared a few months after Saint Bartholomew, when at the instigation of Catherine de' Medici the order was given to massacre all Protestants. Terror had reigned everywhere, and then as now, superstition had free sway. According to the prophets the end of the world was near.

The end of the world did not come. The impostures of the astrologers were recognized as well as those of necromancers, sorcerers and false prophets. But man is eternally ludicrous. And so we have the same prognostications accompanied by the same fears thirty years later. It is therefore time we knew just what to think about the new star, its position, nature and origin.

Contrary to all the teachings of scholasticism, it is situated in the region of the stars. To be exact, in the constellation of Serpentarius. Its apparition was both sudden and unexpected. It appeared in its full grandeur the first evening and waned daily. Ever since then it has been under observation. It has not changed position, and its aspect is the same as that of other stars, taking part with equal regularity in a single diurnal movement exempt from any displacements in any direction. The distance of this star from the other stars of Serpentarius, measured with the greatest care at different periods, proves its complete immobility in its relation to them. Its character is the same as that of the other stars, and nothing but prejudice can prove the contrary.

It was pointed out that the difficulty about this assimilation was that the variable stars, as opposed to the others, could appear quite suddenly and then wane and disappear. But this distinction, Galileo answered, was only necessary for those who affirmed arbitrarily that the true nature of the stars is an eternal and divine light; whereas as a matter of fact they are material fires, like that of the earth, capable of emitting ashes and cinders which covered them and made them invisible.

Inner fires, causing violent combustion of gases,

were the only possible explanation. They rent the surface and the ensuing conflagration made a brilliant light which could be seen millions of miles away. In order to safeguard the theories of Aristotle these facts had been denied, fantastic explanations invented, and the star spoken of as a recent creation, the caprice of Almighty God. Whereas the ephemeral apparition actually offered an acute contrast to the permanency and regularity of the stars which the adherents of Aristotle were the first to proclaim.

The new star had incontestably always existed in the heavens at the same place until the spontaneous combustion had made it visible. And that it would stay there even after the eruption had died down and the light had disappeared from the naked eye, was equally certain.

These theories of Galileo were the cause of a rupture with the Peripatetics of Padua.

Cremonino was then teaching at the University. He was called the "Genius of Aristotle, the Prince of Philosophers, the Light of Interpreters." The kings of Europe had placed his pictures in their palaces, and he received the highest emoluments ever given a lecturer. Cremonino was as well lodged in Padua as any Cardinal in Rome. His palace was magnificent; he had butlers, valets and many other servants, two coaches and six beautiful horses. At the time of the quarrel with the Jesuits it was he who had been charged with the defence of the Bovists before the Senate. He was not in very good odor with the Inquisition, which, however, could not touch him in the Venetian territory because he was a partisan of Aristotle uncontaminated by Christianity.

Bold in his religion and fanatical in his philosophy,

to him the word of Aristotle dominated everything. It is easy to imagine just how he felt towards the theories concerning the new star which were so insolently hostile to those which were his very reason for being. He couldn't make up his mind whether to be furious or whether to laugh, so great was his indignation. He did not deign even to cast a glance at the heavens. He wanted to treat Galileo's insane notions with silent contempt.

But he was forced to answer. *Noblesse oblige*. The eyes of the world were upon him. So he tried his utmost to prove by every known text that the light which was stated to be in the heavens could not be anywhere but in the elementary region, that is to say under the moon whence came all vicissitudes, according to Aristotle.

The rage of the peripatitioners was not appeased. In January 1605 Lorenzini published his lecture in which he quoted in substance the usual banalities.

Despairing of ever making the University professors realize the absurdity of their attitude, Galileo made a direct appeal to the good sense of the public. He published in Paduan dialect, under a *nom de plume* and in humoristic form, a few pages entitled "Dialogo de Ceco di Ronchitti." In it two peasants, Matteo and Natale, complained about the aridity of the soil and attributed the cause to the apparition of this star. They then proceeded to wonder whether the star really was new, and whether the fact that it had not been seen before really proved that it had not previously existed. Matteo had not read the work of Lorenzini, but he doubted whether the author was a philosopher. To discuss the position of a star it behooved him to understand the science thereof, and in

such things the people should side with the mathematicians.

But, replied Natale, the objection is that in placing the star in the firmament degeneration and corruption are introduced in the place of eternal stability. And Matteo replied naïvely that it did not matter anyhow so long as the measurements were correct.

The envious joined the ranks of those who deliberately shut their eyes in order to remain faithful to their pet doctrines, and who fought all observations and calculations with bitter words. Mediocre spirits felt the need of dragging down to their own level men who were superior to them. Unable to imitate them, they were not big enough of soul to admire them and learn from them, so they sought to belittle them.

Baldassar Capra belonged to this category. His father, Aurelio Capra of Milan, had established himself in Padua in order to permit his son, the genius of the family, to attend the lectures at the University. He earned his living by giving fencing lessons, and thus entered into relationship with the patrician Alvigi Cornaro and the doctor Grosso, under whose tuition he initiated himself into the secrets of medicine. He also borrowed from a German friend the recipe of a pill probably containing some synthetic foodstuff which would permit anyone who swallowed it to remain well and strong throughout forty days without taking any nourishment. It is also said that the father Capra had devoted much time to magistry in order to learn how to transform base metals into gold. To these questionable talents he added that of a healer. He was the true type of unscrupulous charlatan.

The son was worthy of his father. A student of medicine at the University, skimming the surface of sci-

entific knowledge, he longed for glory, and being incapable of flights of personal imagination, he found it profitable to appropriate the ideas of others, and then to turn on the very men from whom he had so impudently plagiarized.

After having attended the three lectures on the famous star, he published his *Astronomic Consideration*. In it he accused Galileo of not having given due credit for the source of his knowledge. For of course it was he, Baldassar Capra, who had first made known the date and exact position of the heavenly apparition. Besides that, he added, Galileo in his lecture had not known how to place the star correctly and had given facts which were unacceptable.

Galileo never seems to have defended himself publicly against such impostures. Yet silence meant defeat in the eyes of the public. Perhaps Galileo was content with the esteem of the *élite* and willing to leave Capra his dubious triumph.

The affair of the new star went still further, thanks to Ludovico delle Colombo, an individual of the same stamp as Capra. He figures on various occasions in other disputes. He was one of those men who talk with insolent assurance about things of which they know nothing. In Florence he first published a lecture, and then his "Amusing and Curious Answers to the Dialogo de Ceco di Ronchitti." All that could be said about them was that they were neither amusing nor curious. The author was completely lacking in the graceful lightness of spirit which he imagined he possessed. But he had great faith in himself, and believed, as he wrote to Galileo, that he had given a perfect proof of his finesse and his scientific knowledge.

This adventure would only have been a comic epi-

sode in Galileo's life if it had not ultimately brought about consequences which caused him anxiety and suffering. At this epoch he definitely broke away from Aristotelians, who, hand in glove with the theologians, sought his condemnation. As yet the hostility was silent, heavy with hidden hate and jealousy. But this enmity became more open as it realized the powerful means of which it disposed for annihilating a man and with him all modern science.

Chapter XIII

HOMESICKNESS

THE lectures on the new star created a great stir. Men of vision longed for a scientific revolution, and instinctively they recognized a leader in Galileo.

The Grand Duke of Tuscany began to regret that he had not had the foresight to retain a subject capable of bringing such fame to an alien university. Florentine citizens returning from Venice brought back reports of the admiration and esteem in which Galileo was held by the patricians. Nicolo Giugni, on his return from Padua, where he had received a charming welcome and a course of instruction from Galileo, told his father, Vincenzo, the Grand Chamberlain of the Tuscan Court, of his master's fame and his marvelous invention of the geometric compass.

Vincenzo immediately wrote to Galileo, thanking him for the kindness with which he had treated his son. He told him of a conversation which he had had regarding the compass with the Grand Duchess Christina. He had pointed out its importance and usefulness, as much for monarchs as for lesser individuals, adding that Galileo would doubtless be delighted to offer one to the hereditary Prince Cosimo. He even suggested that Galileo might come to Florence himself during the summer in order to teach Cosimo how to use the instrument.

Vincenzo Giugni knew the pleasure this would give

Galileo. It was also a wise move. There was no greater honor than to be the accredited professor of so powerful a prince.

This happened at the beginning of June, 1605. At the same time Taddeo Galetti brought a suit against Galileo before the tribunal of Venice. He demanded immediate payment of the dowry Galileo had promised his sister Livia.

While Giugni in Florence was appealing to the authorities on Galileo's behalf, the magistracy in Venice was already standing by him. They warned Taddeo to desist from all attacks against Galileo in foreign tribunals, and added that if he wished to sue him he must have recourse to the able jurisdiction of his own country.

The solution was satisfactory, since it was urgent to obtain a delay, and Galileo was deeply grateful to the Grand Duke for this proof of his interest. It was the opening wedge to the Court of Florence.

There are no more ardent patriots than the Florentines. The whole history of Florence is an illustration of their devotion to their country. Though economical to a miserly degree, they never counted the cost when it was a question of contributing towards the embellishment of their town. At times they went into voluntary exile in order to seek their fortunes, but it was always with death in their souls and with the insistent thought of returning some day and enjoying the benefits of their wanderings in their native land.

Galileo was Florentine to the core. In the midst of his studies, his ardent leisure hours and his deep and warm affection for his Venetian friends, homesickness obsessed him. He was incapable of making just comparisons between Venice and Florence. Atavism, the

voice of his ancestors, urged him incessantly. He never dared express these sentiments to his devoted followers who had welcomed him so graciously and who had given him such a wonderful place in their hearts and in their homes. But he was eternally conscious of the call.

Earlier, Mercuriale had written that the University of Padua was the perfect setting for his genius. But this same Mercuriale had been the very one to exhort him later on to undertake the instruction of the heir presumptive of Florence, who was then only twelve years old, but had now turned seventeen. He had told him that Cosimo was intelligent and full of promise, and that to control the education of this prince meant to control the destiny of all Tuscany. It was he, too, who pointed out to him that the study of the new compass would be an excellent means of making himself indispensable to the reigning family.

It was not by mere chance that Giugni had spoken to the Grand Duchess Christina about Galileo. The exiled Florentine had revealed his secret ambition to the Grand Chamberlain, who was only too willing to help him.

In the month of August of the same year Galileo went to spend his holidays in his own home. During this visit he was invited to inscribe himself at the Academy della Crusca, founded long before with the object of purifying the Italian language and giving fresh impetus to literature. This homage touched Galileo deeply.

The Grand Duchess asked him to spend some weeks at Pratolino, the summer residence of the Court. She insisted that this visit would be as favorable to Galileo's health as to the prince's education. She added

with charming lack of formality that she offered him a good room, a seat at her table and a cordial welcome. A sedan chair was to be placed at his disposal.

It was impossible to refuse so kindly and flattering an offer. The air in the mountains may have done him some good, but the chief benefit lay in the gracious encouragement of his sovereigns. The young Prince Cosimo showed him the greatest admiration, respect and affection.

Impossible to resist this atmosphere and the bonds of affection that tied him to his country and his sovereigns, Galileo longed for more. But he was proud. He would not offer his services. His sovereigns had invited him into their midst, let them offer him of their own accord the permanent situation he craved.

In October he returned to Padua. He corresponded constantly with the court of Florence. The letters were full of friendship and mutual consideration.

Galileo was busy making two silver compasses engraved with the arms of the house of Medici. He was also devoting great care to the edition of a book on their uses. This was to be dedicated to the young prince.

Prince Cosimo wrote to the procurator Donato in Venice recommending a raise of salary for Galileo on the renewal of his contract. Galileo had hoped that his Prince's gratitude would take quite a different form, but his hopes were premature.

The Prince's present tutor wrote and told him that, since he had left, his august pupil had not been working with his geometric compass, not from lack of good will but because he had not completely grasped the method, and there was nobody in Florence capable of giving the necessary explanations. It was a roundabout

way of telling him that he was expected the next summer.

Galileo returned the compliment in a letter dated December twenty-ninth, 1605, in which he expressed excessive humility to his prince and stated that he was happy to have been born his subject. He was audacious enough when it was a question of science, and always completely at his ease when talking to the nobility; yet he felt timid in the presence of the young prince, as though this latter stirred in him a sort of religious devotion.

Cosimo himself, who admired him, tried to put him at his ease. "I recognize in your letter the extraordinary modesty which I have always found in you when I had the pleasure of being in your company last summer; but I do not care to see in you this respectful timidity and this fear of being taxed with boldness. You are either not aware of your own merits, or you think that I have failed to recognize them. I have had the direct proof of your rare talents, and I carry in me a faithful and vivid memory of them."

Even all this admiration on the part of his sovereign did not give Galileo more confidence. His excessive modesty was the weakest and yet the most touching quality in his character.

In May, 1606, Galileo went to Venice to obtain permission to print his book on the operation of the geometric compass. He intended to take advantage of his stay there to try and find out whether he was to have a raise in salary during the next term.

But the Senate was troubled. It was making no headway with Pope Paul V who had excommunicated all the Venetians. The Jesuits were full of zeal and busily engendering disobedience and disloyalty. They

had longed to revenge themselves ever since their defeat at Padua on the occasion of their quarrel with the Bovists. The government found itself under the necessity of refusing to shelter them any longer. But these religious aristocrats were not going to let themselves be exiled like any alien trouble-makers without getting what they could out of it and striking in some way at the popular imagination.

And so on the tenth of May at two o'clock in the morning a long procession of Jesuits passed like a succession of sinister ghosts through the darkened streets of Venice. Each one bore a great crucifix about his neck and carried a lighted candle. Silence reigned in their ranks, broken only by the stifled sobs of devotees who could not be reconciled to their loss. The procession went slowly towards the boats which were to carry the disciples of Loyola far away.

Thanks to these disturbances Galileo was forced to return to Padua without learning the decision of the reformators either on the subject of his salary or his book. It was not until June twenty-seventh, 1606, that he received permission to print it; and then, on the fifth of August, the decree was issued which renewed his contract for six years with a raise of two hundred florins, making his salary five hundred and twenty florins in all.

Apart from the moral satisfaction, it was a great material comfort to Galileo, coming as it did at the right moment. For that same month Marina Gamba bore him a third child. This time it was a boy. The baptismal inscription reads—"August twenty-second, 1606, Vincenzo Andrea, son of Maria Andrea Gamba and uncertain father, was baptised by me, Angelo Parocho."

Why the "uncertain father"? Did Galileo deny his children, or was it merely a necessary formula in all documents concerning natural offspring? For it was no secret that Galileo lived with Marina and that he was a father. During the Renaissance what is now called free love was frequent and generally admitted. It was concealed neither from family nor friends. So the expression "uncertain father" must have been a mere formality and not a denial of paternity.

Galileo was very happy to have a son, and gave him his father's name Vincenzo. But his attachment to Cosimo de' Medici was deeper in him than paternal affection. The moment he received an invitation to spend his holidays at Pratolini with the Prince, he left his home at once, without consideration for his newborn child or its mother.

This second stay at Pratolini only strengthened his almost pathologic craving to serve the Grand Duke. He never dared to voice it, but he constantly betrayed his unspoken desire.

On his return to Padua, for instance, on learning of the death of Mercuriale, professor of medicine at Pisa, he wrote immediately, although ill in bed, to the Grand Duchess Christina, and proposed Acquapendente for the vacant post. The candidate was not an unknown man; he had occupied the chair of medicine at Padua with considerable success, and had invented the pills of bitter aloes which were supposed to cure rheumatism.

The letter was a significant indication of his own state of mind. "As is known to Your Serene Highness there is here one Acquapendente, my confidant and friend for many years. He is the very devoted servant of your family, and has not forgotten the honors and

gifts which he received when in Florence. Although he has an excellent position and considerable fame here, he would like to resign because of his age and the constant fatigue caused him by his associations and official duties. He is extremely desirous of finding a situation which will assure him the means of living in comfort, and at the same time the freedom to complete his personal work. In order to satisfy his studious ambition he needs to obtain those titles which others of his profession have acquired, and which can only be granted him by some great prince. That is why I am sure he would gladly serve Your Serene Highness."

By substituting the name of the author of this letter for that of Acquapendente it is easy to trace what was in Galileo's mind. He spent four days composing this letter. It is the keynote of the fixed idea which obsessed him.

He sincerely believed that the ideal situation for a man of science was to be under the patronage of an absolute monarch and not a republic, so that he might not be handicapped by giving lessons, but be enabled instead to devote himself exclusively to his researches and be of benefit to his country. In Germany, Kepler was the Emperor's astronomer; Galileo desired a similar situation with the Grand Duke at Florence.

Despite this favorable reference, Acquapendente was not engaged. The Grand Duke sought information about another doctor and professor of Padua, Minadoi Rovigo. What became of the latter is of no interest, but it is significant that although Galileo had the esteem and admiration of the ducal family he was by no means considered an oracle to be obeyed without question.

This should have given Galileo food for thought,

but his capacity for illusion was so great, when it was a question of his ruling passion, that he soon forgot the blow to his self-respect.

Then his book appeared. It was the one he had dedicated to Cosimo de' Medici on the "Operations of the Geometrical and Military Compasses," published at the author's expense by Pietro Marinelli, a Paduan printer. This opusculum was very successful. It was in demand everywhere, and the limited edition was soon exhausted. Galileo was delighted. It gave greater weight to the homage he wished to pay his prince.

A few months later a Latin work by Baldassar Capra, that bird of ill omen, appeared on the book-stalls. It was practically a literal translation of Galileo's work. Naturally Capra passed himself off as the inventor of the instrument and its corresponding methods. Galileo was furious. Would he be able to convince everybody that he was the victim of a low imposture? What would his Prince think? Would he doubt him? This uncertainty was unbearable.

On April ninth, 1607, he wrote the reformators of the university: "Recently Baldassar Capra of Milan has translated my book into Latin, and in injurious terms swears that I am the usurper of his work. He tries to persuade the world that the book represents the fruits of his labors, that he is the true and legitimate author of it, and that I ought to blush with shame and never more have the audacity to show myself in the presence of men of honor and letters. I herewith address myself to you so that, knowing the facts, you may secure my rehabilitation, and take against this usurper and calumniator the appropriate measures that your wisdom may dictate."

The inquiry was started immediately. Authorized



GALILEO DEFENDS HIMSELF BEFORE THE INQUISITION AT ROME, 1633.

testimony was collected from Paolo Sarpi, Alvise Cornaro and Francesco Contarini—all in Galileo's favor. They empanelled a competent jury to question Capra and rate the value of his ideas. It was not difficult to prove his ignorance, and he was publicly condemned.

But this wasn't enough to appease Galileo. Even if most of Capra's edition was destroyed by order of the authorities, a few might pass the frontier, and some even reach Florence where evil tongues would be bound to insinuate that there is no smoke without fire. It was therefore necessary to write and print a work in his own defence and give it great publicity in order to justify himself.

This kept him at Padua until the end of the month of August, when he ought to have been with the Court at Pratolino since July. When he sent Cosimo his "Defence Against the Calumnies and Impostures of B. Capra" on August twenty-fourth, he wrote: "Preferring death to appearing before Your Serenity with a blot on my honor, I have chosen first to clear and legitimize myself in the eyes of the world and Your Highness, rather than present myself before you with the fear of having left some doubt in your mind."

After this incident relations once more became cordial and affectionate between Galileo and the Tuscan Court. Galileo was commissioned to buy a magnet for the Grand Duke. He naturally thought of Sagredo's, but the situation was delicate.

He wished to prove his zeal to his monarch, and at the same time was afraid of abusing his friend's trust. The magnet was worth its weight in gold, but Sagredo decided to give it up in order to oblige Galileo.

After long negotiations the price was fixed at two

hundred gold écus. It was no small matter to transfer the parcel which was awaited with such impatience.

Galileo, though ill, was forced to go to Venice himself and take a gondola in the middle of the night in order to find the house of the Florentine ambassador to whom the compass was to be entrusted. It was pouring with rain and the gondolier was in a bad temper. It was difficult to distinguish one house from another in the dark. They knocked at innumerable doors. People either slept on or cursed them. They had to retrace their steps. Impossible to find the Ambassador's house; so Galileo took the parcel to the post-master, who accepted it in spite of the unusual hour, impressed no doubt by the superscription.

Galileo, who neglected both his health and his children when it was a question of anything connected with the Court of Florence, feared that he might have displeased his Sovereign because he had not put the precious magnet into the hands of the Resident himself.

He had received a pressing invitation to join his Sovereign the following summer, but a letter arrived which seemed to be lacking in cordiality. Dominated as he was by his ruling passion, the least detail assumed disquieting proportions. He wrote to Belisario Vinta, the Grand Duke's secretary, telling him of his fears and asking his advice. Was he, yes or no, to go to the Court?

The secretary addressed himself to the Grand Duchess and obtained the following answer from her: "Write to Galileo and tell him that he is the greatest and most esteemed mathematician in Christendom, and that the Grand Duke and I desire his presence here, even though it may inconvenience him, in order

that he may teach mathematics to the Prince, our son, and that we shall make an especial effort so that he may not regret his presence among us."

This invitation, so insistent and so imperative, realized Galileo's greatest hopes. He accepted with joy, and spent the rest of his vacation with his Sovereigns.

That same year Prince Cosimo married. Less than a year later the Grand Duke Ferdinand I died. On February third 1609 the heir ascended the throne under the name of Cosimo II. Galileo wrote begging him to deign to cast an eye from his exalted throne on the humblest of his servants.

If they had not ultimately proven very serious, all these excessive marks of servility towards the monarchy of the Medicis might be considered nothing more than childish and rather inglorious. But they were nevertheless the basis of Galileo's ultimate undoing.

Galileo no sooner heard rumors of flattering remarks made about him by the new Grand Duke Cosimo II, than he decided to confess his dear ambition. Since his services were appreciated, he stood ready to abandon his present position in order to be at his Sovereign's orders.

For the best twenty years of his life he had dispensed at the demand of any and all, he said, the small talents that God had given him. But his real prayer was to obtain the freedom and peace to complete his three great works before the end of his life, and to publish them under the auspices of the one whose protection meant everything to him.

The chair at Padua left him free hours, but unfortunately he had to waste them on private teaching, because his salary was not sufficient in itself to meet

his expenses. "It is impossible," he added, "to accept fees from a Republic, no matter how splendid and generous, without putting myself at the disposition of its directors; because I cannot accept public money and devote myself to private interests. I can only hope for such a privilege from an absolute monarch."

His secret desire stood confessed at last. His ambition may have had its value, but judged by the outcome of its realization, it stands condemned as a passion that warped Galileo's very conscience and blinded his critical discernment.

Chapter XIV

THE HISTORY OF THE TELESCOPE

GALILEO went to Venice whenever his health permitted and he could escape from his innumerable occupations. He loved to see his friends, attend meetings in Morosini's house, or browse among the newest editions at the libraries. During a visit there in 1609 he heard a rumor.

It seemed that in Flanders an optician had presented Count Maurice de Nassau with an instrument that brought distant objects nearer and magnified them. There was great amazement. Some gave ear to this mysterious proposition, others shrugged sceptically, but nobody knew anything definite about it.

Some of the genuinely interested tried to get further information at the libraries regarding the construction of this instrument, but it was impossible to get hold of any actual facts. It was generally dismissed as a legend and a myth.

Galileo had a sudden inspiration. His keen mind glimpsed the possibility of this apparently fantastic invention. He left his friends and started back to Padua the same day, too deeply absorbed even to make his adieus. Within twenty-four hours he had figured it out and promptly constructed a similar instrument. He immediately wrote his apologies to his friends and told of the reason for his aberration.

The Dutchman who had made this first telescope

was just an ordinary optician. He knew how to make lenses, but was completely ignorant of all the laws of both optics and geometry. He was a workman, not a scientist. By the merest chance, while manipulating glasses for ordinary spectacles, he happened to look through two of them at the same time. One was concave, the other convex. Holding them at a certain distance from his eyes, he instantly realized the effects, and promptly set to work to make the glass which he presented to the Count of Nassau. Although without scientific basis, it immediately brought him several orders and considerable commercial success.

Galileo, while knowing nothing definite about this glass, reasoned it out for himself. "His invention must comprise either a single glass, or several. It cannot be a single one because such a one would have to be either convex, that is to say thicker in the middle than at the edge, or concave, which is to say thinner in the middle, or even flat. But a flat glass does not modify visible objects. It neither enlarges nor diminishes them. A concave glass will make them smaller; a convex one will magnify them. But at the same time the objects would be indistinct and obscure. Consequently a single glass would not be sufficient to produce the desired effect.

"Considering, therefore, the question of more than one glass, I concluded that, given the aforesaid results, the effect could only be produced by the use of several. I therefore limited myself to examining with care the effects attained by juxtaposing convex and concave glasses, and immediately got the result for which I had hoped."

The moment he had grasped the basic principle of the magnifying glass, Galileo reconstructed the acci-

dental discovery of the Dutch optician with the utmost ease. But he was not content with merely accomplishing this much. He went further. Calculating with mathematical precision, he sought to discover the curve of the lenses and the spacing necessary in order to obtain the maximum magnification of distant objects.

This was essentially a mathematical domain and Galileo quickly established the formulas which gave full value to the discovery. Once he had perfected the theory of the apparatus there was nothing left to do but perfect the material, obtain the best lenses and the most desirable tubes to hold them together.

Slowly but surely he succeeded, and thanks to his perseverance and the thoroughness of his theories, he opened the path to limitless progress.

Galileo's many friends in Venice, delighted with his success, waited for him impatiently, longing to handle and test this marvelous instrument. On the twenty-first of August 1609, two months after his previous departure, he realized their wishes.

Followed by a crowd of patricians he went to the Piazza San Marco. Giovanni Sagredo, Galileo's closest friend, was the only one missing on this day of days. He had left on a mission in the Orient and his absence was the only cloud. Galileo longed to share his happiness with this particular friend.

All these noblemen willingly climbed up the wretched little stairway of the Campanile in order to see the promised miracle with their own eyes. Once at the top, Galileo handed them a white metal tube "three and a half arms' long" and the size of a silver écu in circumference.

"With one eye shut, the other looking through the tube," writes a witness of this memorable scene, "we

distinctly saw beyond Luza Fusina and Marghera to Chioggia, Treviso and even as far as Conigliano, which is nearly fifty-seven kilometres away. We also saw the Campanile, the dome and the façade of the Santa Giustina di Padua. It was possible even to observe worshippers going in and out of San Giacomo di Murano. We watched people on the Traghetto, the column in the Canal of the Varies, and to a marvelous extent the thousand and one details of the lagoon and of the town."

Imagine the enthusiasm of these Venetians, and their pride in this extraordinary man whom they had adopted as one of themselves. All this glory of which Galileo was the centre, reflected on Venice, and in exchange for the joy and the pride with which his discovery was welcomed, he found himself forced to offer a telescope to the country which had shown him such generous hospitality. On August twenty-fourth, 1609, that is to say three days after the experiment, he wrote to the Doge: "Trying by every means in my power not only to occupy the chair of lecturer at Padua satisfactorily, but also to make myself useful to Your Serenity by means of certain inventions, I dare present myself before you with a new glass which is the practical application of the profoundest speculations on perspective, and which brings distant objects so near the eye, and shows them so distinctly and so much enlarged that those who are, let us say, nine miles away appear as they would if only one mile off. It could be of eminent use in either land or sea enterprises. On the sea it would be possible to discern much further away than usual the boats and sails of the enemy, which would result in your being able to know two hours before he was even aware of your

presence, your reciprocal situation, the number and tonnage of his boats, and to judge his strength in order to be able to arm yourself for pursuit, for fight, or for flight. On land you would be able to discover from a certain height the tents and hiding places of the enemy, and see into the interior of fortresses. Consequently, judging this instrument to be worthy of acceptance by Your Serenity, and estimating it at its true value, I have decided to offer it to you and to let you decide at your convenience what should be the opportunities for making further ones."

This letter is rather disappointing. It is not that of a scientist to whom pure knowledge is of greater importance than practical application. It is hard to understand how Galileo could bring himself to sacrifice so marvelous an instrument of scientific observation and make of it merely an engine of war and destruction.

Perhaps he had not realized the incalculable importance of the telescope in relation to his astronomical studies; and the fact that he had no right to give its exclusive use to a State which would only apply it to immediate and practical ends.

But what he himself had failed to grasp, the Governors of Venice had seen at a glance. While accepting the homage which lay behind the gift, the State left him the unrestricted disposal of the telescope for the benefit of science.

Next day Galileo was summoned to the ducal palace and in the presence of the Doge, Leonardo Donato, and the assembled Senate, he proved the efficacy of his glass to the great astonishment of all present. Any number of the Senators and noblemen, even the most aged, climbed again and again up the narrow stairs of

the Venetian belfries in order to watch the boats which were entering the port two hours before they were visible to the naked eye.

At the end of the session, which concluded in a veritable delirium of enthusiasm, they decided to deliberate immediately on some extraordinary manifestation in favor of Galileo. He was asked to leave the hall and wait in a neighboring room. In a very short time the Reformer of the university, Antonio Priuli, came to announce the result of the conference.

While shaking Galileo's hands with undisguised emotion, he told him that in recognition of the services rendered during seventeen years to the Republic, and of the homage shown by his gift of the instrument, they proposed to nominate him professor for life with a fee of one thousand florins a year, and to inaugurate this new payment immediately in spite of the fact that his present contract still had a year to run.

Deeply touched, Galileo thanked him and accepted. In the intoxication of this solemn moment, he forgot his secret hopes. Priuli took him in his arms and said: "Since I am in power this week and have the right to command as I please, I decree that this very day the Senate shall reassemble in order to read aloud and confirm your nomination officially.

Thus ran the decree:

"Master Galileo Galilei has been lecturing for seventeen years on mathematics to the general satisfaction and advantage of our celebrated University of Padua. Besides this he has made known to the world various inventions which not only honor him, but are of universal interest. Notably he has lately constructed an instrument based on

the secrets of perspective and capable of bringing nearer objects at a great distance. As it is seemly that the gratitude and munificence of this Council should ever recognize those who work in the public interest, it is hereby voted that Master Galileo Galilei be nominated lecturer of mathematics at the university of Padua for the rest of his life with a fee of one thousand florins a year."

This decree was welcomed with great applause and unanimously voted. The Republic of the Elect knew how to reward its faithful servants and to show them an apotheosis which placed them above the government itself.

Galileo felt himself exalted, not only by his success but by the encouragement he received from this patrician society which was so wise and so generous. He saw himself bound to it not only by the life contract which the Senate had voted in so unusual and spontaneous a manner, but above all by the farseeing and vivid appreciation which poured in on him from every side.

He really believed at this moment that he had given up his project of establishing himself in his own country, and that he had adopted Venice, the brilliant and superlative, as his true country, his intellectual home.

He promptly wrote to his brother-in-law, Benedetto Landucci, and, in telling him of the recent events, pointed out that his hopes of repatriating himself had vanished, but that the cause was well worth while.

The news of this initial honor offered to an outsider, a foreigner, by so powerful and famous a republic, spread not only in Italy but throughout Europe, thanks no doubt to the Venetian ambassadors who

kept themselves well informed of all notable events in their own country. From all sides Galileo received congratulations, praises and pressing demands for telescopes. Not only students wanted them, but noblemen and monks too. The Senate did not oppose the general distribution of the instrument; and Galileo, though until this moment pressed for money, never had the weakness to exploit his invention commercially.

Giulia Ammannati, Galileo's mother, suddenly decided that this was the moment to come to Padua. Did she come to share Galileo's triumph or to see her grandchildren? She was not an easy-going person, and she did not create happiness around her. Ever bitter of soul, her vile temper had become dominant as she aged, and life with her around was anything but pleasant.

Galileo showed considerable patience with her. He probably suffered bitterly from the fact that he was unable to love his mother, who was sacred to him. His brother, Michaelangelo, had no such scruples, and did not trouble to hide his feelings towards her. He even wrote: "I am not surprised to learn that our mother is as unbearable as ever, but she has let herself go to such an extent that we shall probably not have to put up with her much longer, and then there will be an end to all this dissension."

When this shrew, in September or October of the year 1609, came to stay in Galileo's peaceful home, she managed to create discord, intrigues and worries. Marina Gamba bore the brunt of it. It was on her that Giulia Ammannati vented her ill humor without even having the legal rights of a mother-in-law. She also made common cause with the servants, and urged

one of them, Alessandro Piersanti, who had always been most devoted, to steal telescopic parts which she counted on being able to sell to some Florentine amateur.

It is horrible to think of the unspeakable scenes this infamous mother caused in this house where Galileo's disciples and admirers gathered together. What secret suffering must have embittered Galileo's glory. What humiliation he must have felt. His mother dishonored him, and yet he never failed in deference towards her.

In spite of appearances, life was not all success and glory, and poor Galileo knew perhaps better than anyone else the constant struggles and miseries of human existence. He was forced not only to solve the problems of science, but also to conquer his disgust and revolt, to suffer innumerable petty worries and annoyances, and to triumph over himself as well as over others. In order to make peace he had to let his mother take his little daughter Virginia away with her. The child was only nine years old and was far from happy with her grandmother.

Chapter XV

SIDEREUS NUNCIUS

THE heavenly message, the good news brought to the world—that is the meaning of the words which created an epoch.

The year 1610. That is a date unique in the history of humanity. It opened up an unknown world to the mind and the spirit. It brought about an upheaval of values on a moral as well as on an intellectual plane; a collective emotion without precedent, and above all a mental attitude which created a definite break with the past. Galileo was the father of this revelation.

He took advantage of every spare moment, particularly his nights, to bring his telescope to perfection. He himself (for in that age men were both thinkers and workers) manufactured his lenses and improved them, increasing their power to such an extent that he finally managed to construct instruments that enlarged objects to more than thirty-two thousand times their size. Inevitably he turned the instrument towards the skies. From that moment the great revelation, or rather the infinite series of great revelations, began.

First he observed the moon which, thanks to the telescope, seemed to be barely two terrestrial diameters from the earth. For centuries the moon had been supposed to have an entirely smooth surface, incorruptible, of course, as befitted a phenomenon which

was considered almost divine. But through his glasses Galileo realized that the moon was divided up into darker and lighter planes just like the earth. Far from being smooth and regular, it was covered with mountains and lakes, seas and islands. The illusion of light and dark on its surfaces was really caused by the mountain tops and the consequent valleys. As the sun rose the dark spots on the moon were lighted at one side exactly like the earth at sunrise.

And then Galileo grasped the revolutionary fact that, far from being luminous in itself, the moon was lighted firstly by the sun, and secondly by our own corruptible earth.

In spite of the obvious existence of water and atmosphere he did not jump to the conclusion that the moon was inhabited. Apparently it was light for fifteen days at a time and then dark for fifteen more, when out of the radius of the sun's rays. This was bound to cause excessive heat or cold, and it would be impossible for animals or plants to survive under either condition. Galileo even discovered a method of measuring the height of the lunar mountains, and judged them bigger than any found on earth.

On the other hand Galileo noticed that, unlike the moon, the fixed stars did not appear any bigger through the telescope. This was because it is their radiation and not the stars themselves which are visible to the naked eye. The telescope eliminated the blinding rays and permitted the observation of the actual stars isolated in their luminosity. They differed from the planets in that they were fulgent, but without precise form.

There had been so much excitement in 1604 about one lone new star. Whatever would happen when he

stated that by means of his telescope he could see hundreds of new ones? Their numbers were supposed to have been counted with great exactitude. Add one more or one less and traditional conception of the celestial edifice accredited throughout generations collapsed.

According to the poets and philosophers of old the Milky Way was the divine stream crossed by souls after their death, washing away the memory of their past existences before they began the cycle of a new life. Aristotle, who was more prosaic, defined it as a group of clouds, and some of his disciples supposed it to be merely a denser spot in the heavens. These theories had been considered satisfactory. Nobody had ever tried to verify them or fathom the unknown.

But Galileo was not satisfied with theories. He wanted clear vision. He realized that this river of milk which flowed through the heavens was really an incalculable multitude of minute stars, and even perhaps a certain amount of nebulae.

In any case his close observation of the principal planets, their changing position and size, proved that they rotated around the sun and that the intuition of thinkers who had always been jeered at or persecuted by their contemporaries, had been correct after all.

The most miraculous result of all this exploring was the discovery of the four satellites of Jupiter. At first Galileo thought he perceived three fixed stars. Suddenly he noticed a fourth. After watching them every night for weeks and months, he realized a truth that he had hardly dared voice because it was so amazing and so opposed to all previous convictions.

No less than four planets revolved around Jupiter with astounding rapidity, the slowest of them taking sixteen days to cover its singular route!

There is a page in Galileo's manuscripts written with a trembling hand. It is the famous page in which he tells of his discovery of these satellites. Day by day, as a result of his nightly sessions, the astronomer tremulously entered the successive positions of these unsuspected stars in his diary. Fearfully he foresaw that the result would be a concentrated picture of the whole enigma of the skies as calculated by Copernicus and guessed at by Giordano Bruno, without their ever having seen an actual illustration or having even dared hope for the possibility of seeing it. It was given to Galileo to see with his own eyes what had only been a vague calculation on the part of his illustrious predecessors.

In March, 1610, Galileo, in his book entitled *Sidereus Nuncius*, revealed to the astonished world the science of astronomical facts and a positive knowledge of an infinite universe. He could easily have attacked the dogma of ancient astronomy which was allied so closely to that of religion. He might have shown that the movements and alteration of the planets and the satellites of Jupiter were just so many unassailable proofs of the system of Copernicus. But to make a direct attack on accepted beliefs was deliberately to check his own efforts and to diminish the value of his science, and Galileo had no desire to enter into the realm of prejudices and theological theories. A fact is a fact. His duty was to classify and indicate the precise conditions under which such facts could be observed.

It seemed to him vain to proclaim that the church had no right to qualify astronomical statements as mistaken. It would only create irritation without con-

viction; since the church believed that it held the living facts from God Himself.

It might, however, be possible to present the facts without seeming to attach them directly to the system of Copernicus and even confirm those doctrines and pave the way without provoking the church and compromising the future of science.

Galileo was haunted by the horrible memory of Giordano Bruno and his unspeakable death. He decided that the wisest thing to do was to state facts which could be proven by anyone, without complicating such facts with either theological or philosophical controversies.

At that time there was no distinction between the authentic facts of science and the intuitive facts of reason and religion. Nobody had as yet perceived the absurdity of subordinating reality to preconceived ideas, or, even worse, to the authority of the ancient philosophers whose meanings had been deformed almost beyond recognition by errors in transcription. They did not realize the abyss which separated the new thought from their inherited beliefs, nor the spiritual upheaval which was to revolutionize the future.

The *Sidereus Nuncius* was dedicated to Cosimo II, to whom Galileo also wished to consecrate the marvelous satellites. Should he call these planets Cosmic (from Cosimo), or Medicean (from Medici)? His sovereign himself answered that he preferred the second denomination because the first seemed to him slightly equivocal.

After sending the Grand Duke a copy of his book and the actual telescope which he himself had used for making his discoveries, in order that he might

verify the written words, Galileo offered to go to Pisa during the Easter holidays and teach his prince the delicate manipulation of the instrument. One of the Grand Duke's carriages was sent in great haste in order that Galileo might make the journey in comfort.

Galileo was only too anxious to prove the truth of his discovery, notably for the sake of science, but also for the sake of his Prince. He wished the admiration which was being given the Medicean stars to reflect on their namesake. Once in Pisa, he showed his sovereign and his suite as well as many professors, the marvels that he had announced in his message.

The Duke of Bavaria, the Elector of Cologne and the Cardinal del Monte all begged for telescopes by which they might see these wonders with their own eyes. All the Courts of Europe were promptly supplied with the means of proving the existence of this sidereal universe which bore the august name of Cosimo II. Galileo's devotion towards his idol was thus manifested by more than mere words.

So great was the curiosity aroused by the announcement of his discoveries that Galileo gave three lectures. At the same time a dissertation by the illustrious astronomer Kepler arrived from Germany and proved entirely favorable to *Sidereus Nuncius*.

But now the hidden hostility began to break out. Cremonino, who had refused in 1604 to admit the presence of a new star in the immutable heavens, would hear nothing of this army of stars of which there was apparently no end. He said that Galileo must have invented them. He showed himself the archenemy of these fantastic notions, and obstinately refused to look through a telescope in order not to

commit treason towards Aristotle. He sneered publicly at these supposed discoveries which could be nothing more or less than a poor joke or an hallucination.

Cremonino was someone in the eyes of the people, and he also stood high in the estimation of *littérateurs* and kings. His authoritative ridicule constituted a serious obstacle to the recognition of Galileo's statements, in spite of the fact that they could be proven. The situation was paradoxical. Facts must be made to conform to prejudice, or the facts were erroneous.

The news from Paris was not any more reassuring. The great professors of the Sorbonne laughed themselves sick over *Sidereus Nuncius*.

"Their reasons for disbelieving are infantile," wrote Galileo to Carosi, who was practising medicine in Paris, "for they seem to imagine that I am such a fool as not to recognize after observations repeated thousands of times with my telescope the mistakes of which they speak who have never made a single like experiment. Do they suppose that I am sufficiently stupid to compromise my reputation and fool my prince? My telescope is a real telescope, and the Medicean planets are planets, and they always will be planets. These men who dismiss me so lightly should in common justice write their opinions as I have written mine, and not throw empty words to the winds."

Although very sure of his proven facts, Galileo was nevertheless upset by the sarcasm of his adversaries. The prestige of Cosimo II was also at stake. The ruler was beginning to be perturbed by the opposition which the discoveries were evoking. What was he to believe? A rumor was abroad that the whole thing was a deception and that the telescope was

faked. It was also said that there could not be more than seven planets in the sky since the sacred Jewish candelabra had only seven branches. Bossuet wrote: "It is all very well to have the truth before your eyes, but if you don't open your eyes you cannot see it."

The bitterest irony of all this lay in the fact that the Prince, although having looked with his own eyes through the telescope and declared himself convinced at the time, now began to see through the eyes of those who "having eyes, see not". He doubted the evidence of his own senses.

Galileo did his utmost to convince the sceptics and to prove the importance of his invention to his prince. He brought forward all sorts of testimony to appease the monarch's vanity. He showed him a request from the Emperor of Germany for a telescope capable of revealing more stars. Galileo stated that he would not gratify this demand except with his Sovereign's approval.

Thus he belittled the great Emperor of Germany in order to flatter this Florentine kinglet. He also brought to his notice the copy of a letter which had been brought to him on April twentieth, 1610, that is to say a month earlier, by the secretary of Henry IV, King of France and Poland, who was assassinated May fourteenth of the same year. After having begged for a telescope for Queen Marie, *née* de' Medici, the secretary added: "But the most urgent request I have to make is that, when you discover another star, you may decide to give to it the name of the august star of France, the most brilliant in the world, that of Henry, rather than that of Bourbon. You will be doing a deed both legitimate and just which will make you illustrious yourself, and make you and your family

rich and powerful for ever. I hereby give you my word of honor, adding thereunto my devotion towards you and your extraordinary merits. Look carefully and hastily for a new and beautiful star and send me the news at once. Having done what you have done for your own country, you are now in a position to render deserved homage to the virtue and worth of the greatest, most powerful of princes—he who is the wisest, the happiest and the most magnanimous in the world. Besides this, you know that, among all reigning princes and royal families, he has chosen as his legitimate wife and as bearer of his heir a descendant of the Medici, as did Henry II, his predecessor, who also married a Medici. Henry II reigned long with his wife, Catherine, and his three sons, Francis II, Charles IX and Henry III, who were successively kings of France. In glorifying the name of Henry, you compromise the two Kings of France who were related to the Medici, and who brought royal heirs into the world, and thus you will favor even more if possible the family of your Sovereign. Finally you will please the Republic of Venice which is a devoted friend to this crown and His Majesty of France, from whom in exchange they receive good will.”

Galileo brought all this matter before his prince in an attempt to convince him of the truth and grandeur of his discoveries, and to show him that kings who were famous for their victories and their prestige begged for the same homage as he had himself received. He implored him not to give ear to insinuations. Worlds could not be wiped out merely by announcing them nonexistent and abnormal. Why give Galileo’s adversaries strength by hesitating? His prince was retarding progress by his doubts.

"You have seen these stars with your own eyes," Galileo said to him, "and they are dedicated to you. You can find no greater marvels, no matter how long you observe the heavens, and no other monarch will ever receive greater honor."

Galileo was worn out. The consecutive wakeful nights, the endless correspondence, his lessons and his illness all accentuated his longing to be free of his burdens.

He had a significant interview with Belisario Vinta. He stated openly that, if such were the good will of his monarch, he was ready to devote the rest of his life to the service of his own country. He asked for no more money than he was receiving at Padua, but he did ardently wish for the possibility of giving himself more utterly to his researches and completing his works on the constitution of the universe and the laws of motion. At the Florentine Court his rôle would consist of giving scientific advice which would further enterprises useful to the State, and of preventing others which were wasteful. This work would justify his fees.

After much hesitation, the Grand Duke finally made up his mind to grant his request. He sent him a gold necklace and two hundred écus, and consented to take him into his service with the title of The First Mathematician of the University of Pisa.

In this way he intended to profit by the works and glory of the scientist, and yet have him paid by the university. Galileo, who did not see through this subterfuge, said that he would have preferred the title of "First Mathematician and Philosopher to the Grand Duke". He also hoped that he might be granted a loan in order to put a final stop to the demands of his brothers-in-law who made his life a curse with their

insistent demands for the final payment of the promised dowries.

Cosimo II, who was generous when spending the money of others, gave him two titles instead of one: "Chief Mathematician to the University", and "Chief Mathematician and Philosopher to His Highness". He also granted the loan which Galileo needed so desperately. It is perhaps the only good thing this puppet prince ever did.

BOOK THREE

THE RETURN TO FLORENCE

Chapter XVI

THE FIGHT FOR THE TRUTH

THE term finished before the end of June and there was no real reason why Galileo should stay on at Padua. The transport of his household effects by boat should not have taken more than a week, even counting possible delay. On July tenth 1610 Cosimo had sent him an official decree confirming his nomination to the Court. What was keeping him in this part of the country, then?

On the twenty-third an heir to the throne of Tuscany was born. Galileo wrote that he could not sufficiently express his joy over the great news, and that his pen might run on for ever without being able to convey all his prayers for the happiness and prosperity of the "most cultured and most benevolent ruler in the entire world".

But still he did not leave. He wrote to Belisario Vinta, the Grand Duke's secretary, explaining that a thousand and one things, among them the serious illness and ultimate death of his servant, Alessandro Piersanti, were delaying his departure.

As a matter of fact, when the moment actually came for him to leave this country which had been his home for eighteen years, his heart ached. The thought of leaving had become painful to him. In order to put off the evil day, he made every possible excuse. But they were obviously only excuses. He had been away

from his own country since his infancy. Was it plausible that a servant's illness should prevent his return? The excuse did not hold water, though he was known for his consideration towards those around him. Had he gone, the servant would not have been abandoned, since he was leaving his mistress at Padua and the servant would have been just as well, if not better, cared for.

Not only that. Somebody remembered that years before, at the call of his sovereign who was then only the heir, Galileo had not hesitated to desert his mistress and her new-born child. It was not that his feelings toward the Grand Duke had changed, but a new emotion had come over him. He felt a very real sorrow when the moment finally came to leave the house where he had lived through so much happiness and suffering.

Galileo was more assiduous than ever in his attendance at the academic reunions and at the meetings in the libraries and at the chemist's. He wanted to make the most of the few days that were left to him, to live until the eleventh hour in the spirit of liberty and enthusiasm, to bind as tightly as possible the bonds of friendship and to rediscover all his early joys.

Preparations for his trip and the care of his sick servant did not prevent his continued methodical searching of the heavens, and he made a marvelous discovery which he himself called miracle of miracles.

Under the oath of secrecy he told Vinta and some friends about it. Saturn, which to the naked eye had seemed to stand alone, proved through the telescope to be in reality a group of three stars in a straight line, barely separated and always keeping the same distance apart. Galileo did not suspect that the two

luminous points that accompanied Saturn on either side were really nothing more or less than the protruding sides of its ring. He did realize that these points of light could not be satellites, since their distance from each other never varied; neither could they be fixed stars since they followed Saturn in its own particular orbit.

He did not dare go any further since handicapped by his telescope's limited powers of observation, and was satisfied merely to note what he had seen. But he continued to search for the solution of this enigma which never ceased to intrigue him. His efforts were unrewarded. It was Huygens who discovered the presence of this ring fifty years later with a much more powerful instrument.

Galileo had always told his adversaries that they should not be afraid to write down and sign their contradictions in order to avoid false rumors.

A certain Martin Horky of Bohemian origin, was the first to take up the challenge. He had been one of Galileo's most constant listeners at the university. At his own expense he published an article entitled "A very Brief Peregrination Against *Nuncius Side-reus*" in Latin. He began by stating that it was not Galileo but Baptista della Porta, a famous Neapolitan writer, who had first invented the principles of the telescope and who had mentioned it in his work on natural magic. This insinuation was essentially untrue. Della Porta himself, who was on friendly terms with Galileo, had never taken credit for the invention. "What is more," Horky wrote, "there are only seven planets in the sky. All the philosophers and all the mathematicians, both religious and laic, have taught

it, affirmed it, and proven it. These are Saturn, Jupiter, Mars, the Sun, Venus, Mercury and the Moon."

As usual, the sun was classed among the errant stars because its movements, like that of the planets, apparently differed from that of the stars which were embedded in the higher firmament.

"I wish to add," he said, "that there are not four new planets round Jupiter. I have looked and looked with and without a telescope. I have never been able to see them, because there is no such thing in Nature and it is extreme foolishness to associate them with Jupiter." He finished by saying that it was "disgraceful to attempt to fool the entire world. Are the mathematicians blind, then? If they can see stars of all sizes, the nebulae and the slightest heavenly phenomena, why is it they cannot see these famous satellites? Because they are nothing but a chimera based on trickery. Even supposing they do exist, try to imagine the consequences. The result would be that each one of them would have its proper sphere and its individual movement; and it would therefore be necessary to calculate four new heavens contrary to everything written by Ptolemy, Aristotle and all the other masters. The four planets, like the quadrature of the circle and the Philosopher's Stone, are an impossible Utopia".

The people thus assimilated and apparently digested observations based on heaven knows what occult beliefs. This eloquent document constitutes an admirable key to the spirit that reigned at this epoch, and which is the complete negation of all scientific progress. It shows better than anything else the appalling difficulties which had to be overcome and the bitter battles which were constantly being fought to bring about

the triumph of the truth. Galileo wrote to Kepler, one of the few men capable of understanding him, and thanked him for being the only one who had ever published an absolute confirmation of his discoveries, and above all for not having abandoned him at a moment when he felt himself completely isolated by universal doubt and ignorance. In this letter of August nineteenth, probably in an effort to cheer himself up in the midst of all his disillusion, he made a pun at Horky's expense which can only be fully appreciated in the original, but the point of it is clear:

"In descending from the heavens to Orcus (which means Hell, and is also the Latin for Horky) you will notice that he lacks neither audacity, nor stupidity, nor ignorance. In other words, there are no words to describe him. Let us leave him in his darkness, since the abuse of such as he cannot touch me. Neither giants nor pigmies can do aught against Jupiter. Let the sycophants bark as they may, Jupiter will remain immovably in the heavens.

"You have asked me, my dear Kepler, to give you further proofs of my discoveries. I allow myself to indicate the Grand Duke of Tuscany who, during the last months at Pisa, personally observed the Medicean planets. He has engaged me with a salary of one thousand gold écus a year and with the title of 'Philosopher and Mathematician to His Royal Highness,' without making any demands on me. He has given me free time and peace in which to finish my books on Mechanics and the Constitution of the Universe. As further proof, there is the fact that at Venice

I was granted emoluments which have never been attained by professors of mathematics until now, and I could remain in Padua the rest of my life if I wished to. Giulio de' Medici, the brother of the ambassador to Prague, has also observed the satellites during my visit to Pisa.

"At Pisa, my dear Kepler, as well as at Florence, Bologna and Padua, there are innumerable people who have also seen them, but they all hesitate and remain silent. One of my adversaries in Venice states with assurance, after having frequently observed them, that they could not be planets since they were always seen either following or preceding Jupiter. On this I will make no comment. Shall I rail with Democritus or lament with Heraclitus?

"Finally, my dear friend, let us laugh together over the insensate stupidity of the vulgar. What are we to say about the leading philosopher of the Gymnasium¹ who, blinded by bitter obstinacy and in spite of my earnest and frequent offers, has never consented to look at the planets or moon, or even the telescope. His ears, like his eyes, are closed to the truth. This sort of man imagines that philosophy is a book like *The Aeneid* or *The Odyssey*, and that truth is to be found, not in the world of nature, but in the presentation of texts.

"How you would have laughed, great Kepler, if you could have heard what one of the first professors of the university of Pisa² said against me in front of the Grand Duke when he tried, by logical (sic) arguments rather resembling the in-

¹ Cesare Cremonini, famous professor of Philosophy at Padua.

² Libri, Professor of Philosophy at Pisa.

cantations of sorcery, to tear the new planets from the heavens and wipe them out."

Galileo might very well laugh with Kepler and the intelligent minority, but this did not prevent the sheer mass of his adversaries from being a crushing one. The battle was unequal.

Galileo was still delaying his departure. In order to propitiate his sovereign, he announced definitely on August twentieth that the very next week he would leave for Venice where he would see his goods put on board ship and then go on to Bologna where he would await the carriage promised by the Grand Duke. His health would not allow him to make the trip on horseback in view of the bad roads, which were anything but safe.

This time his preparations for his return to Florence were serious. The moment had come for parting from Marina Gamba who had played a very insignificant rôle in Galileo's life. Their children were the only bond between them, the only reason, undoubtedly, why they had continued living together for so long. Galileo certainly had nothing for which to reproach his mistress, who was humble and devoted. He decided to leave his son Vincenzio behind, as the latter was too young to do without his mother, and he did not neglect to arrange for her support and to make the separation as easy as possible.

Marina Gamba was neither sufficiently decorative nor interesting to figure in the magnificent frame of the Court of Florence. In a way she was sacrificed to force of circumstances. But the real reason was that she no longer satisfied her lover. Galileo loved women, and could not find in monogamy all the subtleties of

sensual pleasure that his imagination demanded. It is perhaps one of the most fatal qualities of a brain-worker that he cannot limit himself to one form of beauty, or one form of companionship.

Galileo left with his daughter Livia in the Duke's carriage, and arrived at Florence on September eleventh or twelfth, after having stopped over for three or four days at Bologna. There he took advantage of the opportunity to show Magini and other mathematicians the celestial phenomena which were under so much discussion but of which the world as a whole still remained to be convinced.

Chapter XVII

THE HOURS OF WAITING

THE house which Galileo had chosen at Florence had a great terrace from which he would be able to continue his observations. But as it was customary in those days not to move before All Saints' Day, he was unable to install himself in his new home at once. For two months he was forced to live either at a boarding-house or with friends, which excluded the possibility of serious work. He had no time to make the instruments for which there was constant demand.

Florentine houses were extremely spacious. They usually had terraces or loggias. There was running water and toilets with wells; the sort that are still found in lots of modern Parisian houses and which did not exist in the Palace of Versailles until a hundred years later. The Renaissance, especially in Florence, had made an art of domestic appurtenances. The interiors were clean and light and the house linen particularly fine and elegant. Florentines had the gift of neatness, and, unlike the patricians of Venice, a taste for sobriety and economy. They laid in a supply of oil and wine for a year's needs, as they still do nowadays. Their private lives were simple and their receptions unostentatious. At the table of Lorenzo de' Medici surnamed The Magnificent, no distinction was made among the guests. Each one took his place according to the time of his arrival.

Save in rare and famous cases, the women were not educated. They held hardly any place at all in the intellectual ferment of the Renaissance; but they were excellent housewives. They spent their spare time weaving. They were the victims of their epoch and the slaves of their lords and masters.

Marriage was not considered the only possible form of union. It was a common practice for a man to have natural as well as legitimate offspring, and this social tolerance created cordial relations between parents and their natural children.

License was fashionable; more so in Florence than anywhere else in Italy. Their plays and their carnival songs, fragments of which have been handed down, are all proofs of this. The presence of respectable women was no obstacle to complete frankness of speech. Towards religion the attitude of the population was equivocal. Marvelous churches were raised, but more to gratify national pride than real piety. Religious observances were often treated with more than sly irreverence. Stories are told which are significant of this. It was considered a great joke to pour ink into the Holy Water, to put evil-smelling matter into the censers, or to enter the Cathedral with goats and sometimes even on horseback.

These tricks, however, did not eradicate a certain superstitious awe. The spirit of the Florentines was extremely complex, and it is because no allowance has been made for the innumerable and subtle shadings of their character, that they have so often been wrongly accused of lacking consistency and sincerity.

Florence was one of the essential centers of humanism and culture. Perrens writes: "In the domain of the arts, as well as that of literature, Florence holds first

place. In Florence, as nowhere else, painting was raised to the standard of sculpture, thereby adding to the beauty of the human form, which is the ultimate aim of statuary art, a form of expressiveness without which it can never reach the front rank."

At the same time Cosimo de' Medici, who had founded the Platonian Academy, made Marcel Ficini, the son of his doctor, study Plato's philosophy, having destined him to become the head of a new régime. The establishment of this academy was the first definite sign of the growing reaction against Aristotle. As a matter of fact when Galileo returned to Florence the academy had not been in existence for more than a century. Art itself showed decadence, although taste for beauty and culture still predominated. The air was full of it. What Florence really lacked was moral independence where the church was concerned. Especially during the reign of Cosimo I, a close alliance had been established with the Holy See, and the Inquisition had unlimited power throughout all Florentine territory.

This characteristic differed essentially from the political standing of Venice. Most of the troubles that marred Galileo's triumph arose out of it.

While waiting to get back to his own work, Galileo watched the activity of his friends with interest. He was delighted to hear that Kepler, who had never doubted their existence, had finally been able to see the satellites of Jupiter for himself, thanks to the telescope sent by the Elector of Cologne. He begged Giuliano de' Medici, ambassador to Prague, to send him Kepler's two treatises on optics and the star of 1604, as well as the work of an unknown man on the

movement of the earth which he found listed in the catalogue of the Frankfort Fair.

He received a letter contradicting the assertions of Martin Horky from this same correspondent; another on the same subject from a certain Roffeni whom he had lately met in Bologna; and a second dissertation by Kepler.

Here was enough material to hang Horky, as Galileo himself said, but it was necessary to translate Roffeni's writings into Latin before printing them, and also to correct Kepler's communications, for in his haste the latter had allowed many of his adversaries' inaccuracies to slip by unchallenged. In Florence Michelangelo Buonarroti, a very young member of the Florentine and Crusca Academies, dedicated a beautiful poem to the glory of the Medicean planets.

Friends kept him in touch with all rumors abroad in Padua. They had heard about Kepler having actually stated that he had seen the Medicean stars with his telescope. The Bolzetta library, a brilliant literary center, started a rumor that a Scotchman, John Wedderburn, intended to publish an answer to the "Peregrination" by the Bohemian Horky, in favor of the *Nuncius*. But Magini, the professor Galileo had visited in Bologna, was said to be stating that he personally had never been able to see the satellites, in spite of his peerings through the telescope. And yet this man was a candidate for the chair of mathematics vacated by Galileo at Padua.

Everywhere Galileo's opinions were being discussed with asperity or enthusiasm. Marco Welser, a brilliant German student, who spoke Italian fluently, and who deserved to be a member of the Academy

of Lencei at Rome, sent certain objections written by one of his friends on the subject of the mountains of the moon. Their height as given by Galileo's measurements appeared doubtful. With great breadth of spirit, Galileo answered that he would be delighted to enter into discussion with any courteous opponent and acknowledge his mistakes if they were proven. He considered that intelligent and sincere discussion was more profitable to science than ignorant praise.

One of the finest of all the men who took an interest in Galileo's scientific discoveries was Benedetto Castelli. He was a Benedictine Father and a former pupil at Padua. He was also one of the first to confirm the facts divulged in the *Nuncius*. He ultimately played an important part in Galileo's history. His devotion to his master was such that he decided to give up his country and his family and settle in Padua at the Monastery of Santa Guistina, in order to be near the man in whom he had placed all his hopes for the progress of scientific knowledge.

He had hardly succeeded in getting the necessary authorisation to leave Brescia, his native town, when he learned that Galileo was entering the service of the Grand Duke of Florence. He was forced to start all over again.

He longed to serve Galileo, he said, if not in proportion to his gratitude, at least to the utmost of his limited powers. When Martin Horky's libel was published, this devoted follower decided, in conjunction with several noblemen who were admirers of Galileo, to buy copies of Horky's book the moment they appeared in the libraries at Brescia, and to burn them, no matter how many there were, in order that no trace of them should exist in his country.

Castelli was not only a devoted friend, but a very precious collaborator, having great gifts of exactitude, a love of research and a broad mind.

"For some time," he wrote to Galileo, "I have been obsessed by an idea which may be all wrong, but which I submit to your good judgment. If, as I believe, Copernicus' treatises are correct and Venus does revolve around the sun, we ought surely to be able to see it sometimes in part, sometimes wholly? I should like to know whether with the help of your marvelous telescope you have never noticed such a condition which ought to be a conclusive means of silencing the most obstinate of opponents."

Benedetto Castelli, by pure reason and by going on where Copernicus had left off, deduced the phases of Venus that Galileo had already noticed, thereby inaugurating one of the fundamental premises of scientific research—the hypothesis.

Galileo had been following Venus closely and following the planet in all its metamorphoses ever since he had moved into his house in Florence.

"My poor friend," he wrote to Castelli, "it is really funny to think that you believe that these phenomena will convince our opponents. Wouldn't you suppose that my early demonstrations were sufficient to convince those who use their minds and really want to know the truth? But for those who are wilfully blind and only seek the applause of the masses, even the advent of the stars themselves, if they descended upon the earth to prove their nature, would not suffice. So let us find out things for ourselves and be content with the ensuing satisfaction. As for winning public opinion and the agreement of booky philos-

ophers, we may as well give up any desire or hope of doing so."

In spite of these cynical words, Galileo did not give up the fight. He was only going through a temporary phase of discouragement familiar to all innovators. All intellectual workers suffer from it when confronted by the hostility of an ungrateful public or a task which is exceptionally difficult. But a worse thing they have to face is the fact that friends who wish to defend them sometimes do more harm than good, basing their experience on emotional devotion rather than understanding. John Wedderburn, who published a refutation of Horky's book that same year, comes under this category. By the absurdity of his arguments he managed to discredit Galileo more than he served him.

The observation of the various phases of Venus had confirmed in Galileo's mind the fact that the planets which were on the same plane as the sun were opaque bodies, shadowy like the earth and having no light of their own. The opposition did not lie, as had been thought throughout centuries, between the sky and the earth, but between the sun and the planets, including the earth. Although Galileo was certain of the correctness of this final conclusion he never mentioned it, either in his lectures or in his writings. It remained latent but easy of deduction for those who had grasped the principle. To state it definitely and prove that the earth was of the same consistency as the mobile planets was to evoke Giordano Bruno's tragic ghost.

The philosopher Libri had just died at Pisa. It was he who had pretended that by logical reasoning he could exorcise and destroy the recent observations.

Galileo said of him that on his way to heaven he might perhaps have a chance to see what he had never perceived on this earth.

The Jesuit Fathers of the Roman College, however, were said to have made experiments which confirmed the existence of the satellites of Jupiter. The principal mathematician of this college, Clavio, even wrote a sort of official statement to Galileo. He had seen not only the Medicean stars, but several others, including Saturn with its two satellites. Clavio congratulated Galileo on his work and implored him to continue his researches.

In the midst of the general hostility the corroboration of such a witness constituted a great victory. The moment he received the letter, Galileo passed it on to the doubters, and thanks to it he obtained many new adherents.

Such was the state of mind at that time that the authoritative statement of one such man was more convincing than direct proof by experiment

It was a great joy for Galileo to know that he was upheld by the Jesuits of the Roman College who were considered somewhat as the head-keepers of official science, and whose prestige, both on the subject of philosophy and theology, was considerable. He decided to go to Rome in order to obtain the protection of the Pope and the Cardinals, having at last won the support of the mathematicians.

Chapter XVIII

THE TRIUMPH AT ROME

ON THE strength of Father Clavio's encouragement, Galileo asked the Grand Duke's permission to leave for Rome. There was no answer. He was forced to renew his request on January fifteenth, 1611. He pointed out that the moment had come to expose the basic facts of his discoveries and bring science out into the light instead of keeping it hidden like some shameful secret. He excused himself for seeming anxious and impatient, but the cause seemed to have reached such a crisis that the sovereign's support might be the only means of saving it.

Belisario Vinta upheld Galileo's request. He pointed out to his royal master that it was the time of year most favorable to the observation of the Medicean planets, and that this voyage ought not to be postponed too long after the authorised confirmation of Kepler and Father Clavio. Once in Rome, the truth would be revealed to the Pope, the facts of the world's movement be definitely proven, and the general conviction of the astronomers ensue. He therefore advised that a carriage be sent to Galileo immediately, together with the funds necessary for the trip, and an introduction to the ambassador of Florence at Rome.

But still the order was not given, although a month had passed since the beginning of this correspond-

ence. Father Griemberger, a collaborator of Father Clavio's, testified to a series of observations which were all in Galileo's favor.

The latter became more and more impatient. He was tied hand and foot. He wrote to Father Clavio, who could not understand the reason for these delays, and told him that they were due to ill health and an exceptional amount of work. He did not dare tell the truth about his sovereign's attitude, so he kept on repeating that by the grace of God and the Grand Duke, he would soon be under way.

It was now the middle of March. Still no orders! Galileo's nerves were on edge. He began to fear that he would not reach the Eternal City by Easter. He also dreaded a change of mind on the part of his monarch. Everything was going wrong. Why had he ever left Venice!

At last the carriage arrived and Galileo started on his journey. It was then March twenty-second. It had taken three months to persuade the Grand Duke to give his authorization. Galileo had letters of introduction from the Duke to Cardinal Delmonte, Michelangelo Buonarroti and the Cardinal Maffeo Barberini.

On his arrival on March twenty-ninth he was courteously received by the Florentine ambassador, Niccolini. The very same day he presented himself before Cardinal Delmonte who listened to him with intense interest. The great man assured him not only of his support, but of complete victory.

It was a wonderful start. Galileo was surrounded by smiling faces. Everybody seemed well disposed towards him. They were all in admiration before his genius and prejudiced in his favor by the brilliance of his fame.

In the meantime another attack had appeared against the *Nuncius*, made by a Florentine named Francesco Cisi who was ultimately put to death by torture for publishing a libel in Paris in 1618 against the King of France.

Most of his objections were wild and childish: a few were dangerous because they raised the Biblical question. But they succeeded in creating a further spirit of doubt in ignorant minds, especially as they were dedicated to a prince of the Medicean family.

This prince was the same Don Giovanni with whom Galileo had entered into conflict while he was teaching in Pisa. It hurt Galileo's pride considerably that the Grand Duke should have permitted such an attack to be published against his accredited philosopher and mathematician. His enemies chose to consider it as a proof of his disgrace, and rumors were abroad in Rome that Galileo had had to leave Padua suddenly under the shadow of his sovereign's disapproval.

When Galileo went to see Father Clavio and his collaborators, he found them busy reading this pamphlet. But he soon saw that the Jesuits gave his enemies little credit. It is the justice that must be rendered them in a history where there is little enough to be said in their favor. They were certainly the first to back the *Nuncius* with their authority, and they made public fun of Cisi's ignorant outburst.

Galileo received a respectful and enthusiastic welcome from them. For two months they had been making methodical observations through the telescope, and had found that the results corroborated Galileo's statements. They had even tried to calculate the periodic positions of the satellites, but gave it up, agreeing with

Kepler that the undertaking was beyond human power.

Statements like these only served to stimulate Galileo. On April twenty-second he visited the Cardinal Maffeo Barberini who showed him the greatest consideration and assured him of his friendship. At this epoch a cardinal was not only a powerful ecclesiastic but a great gentleman in private life. He usually owned one or more palaces and was surrounded by a personal court. Barberini was an intelligent and cultured man, and he greatly admired his visitor's astounding brain which he later glorified in some excellent poems. He took a great interest in all forms of knowledge, and when eleven years later he became Pope (Urban VIII), he protected both art and literature. Flattered by Galileo's visit, he became his acknowledged protector until events separated them and placed them in opposing camps.

Galileo hoped desperately to capture the good will of these powerful prelates on behalf of his discoveries. He put himself out to be agreeable towards those who were not yet heart and soul with him. He attended an academic meeting, at which a great writer, Strozzi, surnamed The Blind, much beloved at the Vatican and by the Medicean family, spoke before a meeting of the élite.

Hoping that the news might reach the ears of the Cardinal and even the Pope himself, Galileo wrote at length to Virginio Orsini, a friend of many great Romans, extolling the beauty of Strozzi's work, which happened to glorify his own doctrine. With obvious intent he mentioned by name those present who had taken part in the discussion.

These naïve tactics bore little fruit, but it is a fur-

ther proof of Galileo's tenacious desire to have the hallmark of Rome on the truths on which his fame and his future depended. At heart he dreaded opposition. He even wrote to Filippo Salviati that he preferred to conciliate Cisi who had attacked and maligned him, rather than publicly denounce the stupidity of an opponent who actually evoked Kepler's authority when the latter had been the very one to hold him up to ridicule. It was dangerous to make enemies at a moment when scientific questions were closely involved in religious and social activities.

The Pope, Paul V, granted him an audience. But this sovereign pontiff was too absorbed by the administration of the state and his multitudinous duties to take much interest in the evolution of the stars. He assured his illustrious visitor of his trust and good will. He might have done more, but that seems to have been the limit of his concessions on Galileo's behalf.

Galileo certainly met a great many people whose adherence and esteem he won. All Rome was talking of the celestial miracles. Princes and cardinals fought for the privilege of having the discoverer of these marvels under their roof. The Duke of Acquasparta, Federigo Cesi, founder of the Lincei, gave a banquet in his honor. It was attended not only by the most eminent philosophers and mathematicians, but also by members of the most exclusive aristocracy. At the end of the meal the guests followed Galileo to a high place and looked through his telescope. They were profoundly struck by Jupiter and its mysterious escort of satellites. They could also see the loggia of the Benediction of St. John Lateran with the inscription by Pope Sixtus V.

It may seem surprising that these illustrious men should turn away from the sky and its mysteries to point the telescope at buildings which they knew so well and which they could examine closely whenever they liked. But it is easy to understand, considering the lies that had been told about the telescope. Had it not been said that the new stars had been painted on the interior of the instrument, thus faking the desired result? But now proof of its efficiency was at hand. How could there be any deception? The inscriptions of St. John Lateran were famous, and if they could be deciphered in spite of their distance, then the hidden stars must be real, since they were being observed through the same instrument.

Every time Galileo showed the satellites or other heavenly marvels, this comparison took place. The acknowledged motive actuating those who took part in these scenes is sufficient to show the psychological attitude of even this cultured society.

Niccolini, with whom Galileo was staying, had to make way for a successor. Galileo feared to be a burden, but the new ambassador gave him a welcome as cordial as that of his predecessor. Still, his position of official Court Philosopher and Mathematician made it unseemly for him to continue to accept the hospitality of his Roman friends. He preferred to remain under the aegis of his own country, and requested an authorization from Florence to live at the Villa Medici which was then called the Garden of the Trinità dei Monti. He assured his sovereign that he would soon bring him proof of total victory and the assurance that the stars named after him would immortalize his name.

During the month of April he was received at the

Quirinal Palace by the illustrious Cardinal Bandini, who in the presence of the princes of the church and other great men, again explored the heavens, and was even the first to observe spots on the sun. Corsini, Dini, Cavalcanti and Strozzi were among those who assisted at this significant discovery.

An official reception given at the Roman college was Galileo's ultimate triumph. Before a vast audience of doctors and nobles, princes and dukes, and high dignitaries of the church, the Reverend Father Odo Malcot expounded the works and merits of their illustrious guest. He spoke about the marvels of Saturn accompanied by the two luminaries, the Medicean planets and Venus.

Galileo listened, deeply moved, unable to believe in a victory which surpassed his wildest hopes. The great Jesuit, Gregory of St. Vincent, who was present, drew a vivid picture of the scene in a letter addressed to one of his colleagues in Belgium on July twenty-seventh 1611. "I doubt," he wrote, "whether the new stars discovered by means of the telescope have created as much stir among you as they have at Rome." He then proceeded to give a detailed account of this memorable occasion which created an ovation to the glory of Galileo of which the echo spread throughout all Europe.

The Cardinal Delmonte said: "If we were still living in the days of the Roman Republic, a monument would be raised to Galileo at the Capitol in honor of the excellence of his genius"; and he sent a personal description of this grandiose affair to the Grand Duke de' Medici.

Galileo returned to Florence on June fourth, accom-

panied by Strozzi. He was drunk with success and joy, and believed that he had finally silenced his adversaries, the Peripatetics. Now who would dare say that the new stars were not in the heavens but in the telescope? Surely so many illustrious witnesses would silence such diabolical insinuations?

Cosimo II was proud of him and prepared a great welcome. He received his Court Mathematician as a national hero bringing immortal glory to his country.

But a sinister cloud was gathering. It was barely perceptible, but ominous.

While the Roman prelates and Jesuits were exalting Galileo's science, there was one who stood apart. This was Cardinal Bellarmine, of the Inquisition.

Jesuit from the age of eighteen, and having assumed the purple in 1598, he was a rigid theologian. At the end of the sixteenth century he had known the dangers of Protestantism and the troubles which menaced the Church. He had lived through hours of bloodshed and agony. He had judged cases of notorious heresy; and his experience had taught him to beware of any innovation which might create doubt in the Faith and bring about the destruction of Catholicism. On the death of Clement VIII, he had refused the nomination of Pope in spite of the unanimous vote of the conclave. He preferred his post of observation which enabled him to watch over the insidious doctrines of Luther and Calvin, which in his eyes were hydra-headed monsters.

He had had occasion to admire the newly discovered stars, but a secret fear worked in him. On April nineteenth 1611—that is to say, during Galileo's stay in Rome—he wrote the following letter to the Roman College.

"I should be glad if you would do me the kindness to let me have your serious opinion on the following points:

- 1) Do you approve that there exist a multitude of fixed stars invisible to the naked eye, particularly in the Milky Way and the nebulae?
- 2) That Saturn is not a single star but three associated stars?
- 3) That Venus is subject to mutations of surface analogous to those of the moon?
- 4) That the surface of the moon is irregular and uneven?
- 5) That around the planet Jupiter are grouped four mobile stars, each with separate and very rapid motion?

"I wish to know this because I have heard varying reports. With your knowledge of mathematics you will easily be able to instruct me whether these affirmations are well founded, or based on false appearances. Kindly join your answer to this paper."

The word "approve" governs each question and reveals Bellarmin's hidden sentiments. The questions which he placed before the mathematicians of his order were really the questions he was asking his conscience as a theologian. Can new discoveries be approved with the interests of the Faith and of the Church at stake? On an ecclesiastical plane, physical facts can only be judged by their moral value.

The Jesuits of the Roman College either did not or would not understand Bellarmin's implied meaning.

“According to your instructions” [they replied]
“we hereby answer in this same letter your questions on the subject of the diverse appearances shown by means of the telescope.

- 1) It is true that multitudinous stars can be seen in the nebulae of Cancer and the Pleiades. As far as the Milky Way is concerned it is not absolutely certain that it is entirely composed of stars, although it is impossible to deny that there are many small ones included in it.
- 2) We have noticed that Saturn is not round like Jupiter and Mars, but oval and oblong. We have never been able to see the lateral detached stars sufficiently clearly to be able to state that they are distinct and apart.
- 3) It is true that Venus waxes and wanes like the Moon.
- 4) It is not possible to deny a great inequality in the surface of the moon; but Father Clavio considers it more probable that it is not a question of uneven surface, but of a difference of density in the general consistency which is manifested by the shadows which are visible even to the naked eye. In any case, up to now we do not possess sufficient certainty on this question to be able to give you information on this point.
- 5) We have undoubtedly seen four stars surrounding Jupiter, which revolve very rapidly, sometimes towards the east, sometimes towards the west, in a nearly straight line. They cannot be fixed stars because their

movement is very rapid and differs from that of the fixed stars. Also their distances from Jupiter vary considerably."

Probably Bellarmin received this answer with a smile, but those of the Jesuits who knew him well must have guessed that something serious was in his mind. He knew too much to allow an apparently in-offensive opinion, which might ultimately prove a heresy, to take hold.

Even the answer sent by the Roman College by no means settled the question. Bellarmin secretly pursued his enquiries, and on May seventeenth, 1611, when Galileo was apparently reaching the height of his career in Rome, the Inquisition sent out this order:—"Let it be looked into whether in the data of the suit against Cesare Creminini, the name of Galileo, professor of Philosophy and Mathematics, does not appear."

This might lead to something definite. Cremonini was in bad odor in Jesuit circles. He had been menaced by the Holy See, though incurring no penalty, thanks to the powerful protection of the Venetian Republic. Galileo had been Cremonini's colleague at Padua. Might he not be compromised in the same affair? Was there not community of thought between them?

The outcome of this line of pursuit was negative, but Bellarmin never tired. For years he followed the evolution of the modern astronomic doctrines and watched for the first indication of heresy. He knew how to wait in silence, feeling sure that his perseverance must ultimately receive its reward.

Galileo suspected nothing of all this. He was full of his triumph, and he thought that at last the hour had

come to bring to light and explain the system of Copernicus.

Yet a warning reached him from Venice which he should not have disregarded.

Francesco Sagredo arrived home from his long voyage in the Orient. He had kept in touch with Venice and had heard of Galileo's successes. He was very grieved to hear that Galileo, who had been his closest friend, had deserted the country which had been so favorable to the development of his genius. He wrote him a prophetic letter, warning him that in leaving Venice he had probably jeopardized his independence.

"And truly," he said, "I believe that God has granted me an especial grace in allowing me to be born in this place which is so beautiful and so different to all others. The liberty and individual manner of life here seem to me an admirable thing, probably unique in the world. Realizing this, my thoughts turn to you who have left us. I see no remedy for it and no compensation. I love to imagine myself still at your side, and I recall all our wonderful associations. But how am I to carry on and develop the amazing ideas which I have always culled from your enlightened conversation? As far as I am concerned, your absence causes me unconsolable sorrow and an irremediable void.

"In what concerns your own interest I must bow to your judgment and your good sense. Here your salary and your other advantages cannot be depreciated. Your expenses were not great, and your needs easily satisfied. You had no need to worry about the next day. Above all, the sovereign liberty which was yours—where can you find it, excepting in Venice? . . .

"You are now living in your own very noble country. You are serving a great prince who is young and full of virtues and promise; but here you only served yourself. You exercised power over those who had power like a very king. The power and the magnanimity of your prince give hope that your devotion and your merit may be rewarded.

"But who can dare be sure that in the tempestuous atmosphere of a Court he will not be, I will not say submerged, but at least worked upon and disturbed by the furious winds of emulation? I will not mention the age of the prince, nor the fact that with the years his temperament and his tastes may necessarily be subject to change—because I am aware of his excellent nature of which the roots cannot produce any other than the best and most abundant fruits. But who knows what the infinite and incomprehensible accidents of the world can bring about, helped by the deceit of evil and envious men who, sowing and raising in the soul of your monarch some false and calumnious idea, may not make at some time demands on his justice which might bring about the ruin of a man as honest as you are?

"Princes may for a little while have the taste for some novelty; but, called constantly to higher interests, they often turn their attention elsewhere. I can easily believe that the Grand Duke likes to look through your telescope at his beautiful city of Florence or some neighboring place, but if the necessity arose to watch what was happening in Italy, in France, in Spain, in Germany, or even the Far East, he would soon put your telescope aside. You might invent one more appropriate to his need, but who is capable of

discovering a telescope with which to discern the madness of wise men, the good counsels of the evil, the intelligence underlying an obstinate and ignorant chief? But we do know that the judgment in these matters is made by an infinite number of fools who are counted by their quantity rather than by their quality."

Sagredo suffered sincerely from his friend's unexpected decision, and he was not the only one to feel and regret his absence. The great patrician, Venier, who still held him in great friendship, could not hide his disappointment, and many others reproached Galileo with having lacked gratitude and courtesy towards the Republic which had given him so unique a demonstration of esteem and affection.

Galileo was touched by these reproaches, but he did not yet feel their true import. The excitement and joy which his successes in Rome had provoked in him made him almost a stranger to himself. At this moment he had no time to dream or to relive the hours of welcome and warm friendship which had been tendered him in Venice and Padua.

The chair at Padua remained unoccupied for a long time. There was always the hope that Galileo might come back. It was felt that in his new situation he might suffer one of those experiences which teach a better knowledge of men and of things.

A year later Sagredo tried again; but, unfortunately for Galileo, in vain.

"Since I note," wrote Sagredo, "that there is no hope of your return, I shall persuade my father to find a new occupant for the chair of mathematics. Your successor will probably be Gloriosi, a man who

is truly intelligent, though cold. The thought of him does not by any means give me complete satisfaction."

Even then, before the new professor was definitely elected, Sagredo consulted Galileo again, and asked him his opinion. It must have been favorable, since Gloriosi was definitely nominated.

Chapter XIX

A RECEPTION AT THE ROYAL PALACE

GALILEO'S success in Rome started an avalanche of envy and intrigue, mixed with a certain amount of honest zeal among those who were faithful to their prejudices. Ludovico delle Colombe placed himself in the foremost rank of the defenders of outraged philosophy and stirred up a lot of excitement as usual.

In some mysterious fashion he had learnt of the sentence regarding the inequalities of the moon in the Jesuits answer to Cardinal Bellarmine. He immediately wrote to the Roman fathers congratulating them because they had not believed "that the moon's surface is covered with rugged excrescences, as Galileo would have us believe." He also hoped to succeed in compromising Father Clavio, who, while not always agreeing with Galileo's interpretations, held him in the highest esteem but had no wish to be involved in all these quarrels.

In Rome there was no end to the discussions. Quoting Magini as his authority, somebody quite unknown asserted that if Galileo's telescope disclosed certain phenomena, Cardinal Farnese had another which revealed entirely opposite effects.

The story of Galileo's triumph in Rome with its inevitable backwash of jealous implications, had scarcely died down when fresh disputes arose on another subject.

On Galileo's return to Florence the Grand Duke gave a banquet in his honor, which was attended by all the Court, members of the university, and ecclesiastical dignitaries.

Among the guests was Cardinal Maffeo Barberini, Legate of the Pope, who happened to be passing through Florence where he was the guest of the sovereigns. The conversation remained pleasant and neutral until the dessert, when a discussion started between Galileo and several peripaticians, chiefly Papazzoni, Buonamici, and the inevitable Ludovico delle Colombe.

It arose out of the statement of one of these professors that ice was water condensed by the cold.

"Say, rather, that it is rarified," answered Galileo; "since it floats and is therefore lighter than water."

The opposing camp promptly affirmed that things float, not because of their lightness, but their surface. For instance, a lump of lead sinks; but lead in wafers or hollow form stays on the surface.

"That is so," answered Galileo. "But note that they do not rise to the surface again if they have been pushed under. Lead is always heavier than water; but if it floats in hollow form it is because it is filled with air, and it will stay on the surface in spite of its spherical form, which, according to you, should carry it to the bottom. The causation which exists, whether the body is immersed or floats, lies in the difference of weight between the solid matter and the medium in which it is placed. Cork, which is lighter than water, floats whether it is placed on the surface, or whether it is pushed to the bottom. It always rises to the surface."

There was a great outcry. They said that Galileo was getting away from his subject in order to fool his

listeners. They called him a sophist and said that he was incapable of understanding Aristotle.

Undisturbed, and with his calm smile which was so exasperating to his opponents, Galileo replied: "The interpretations of facts may be right or wrong, but they never justify the hatred that is felt against those who elaborate them. Because if they are right it is sacrilege to put them aside, and if they are wrong it is merely necessary not to adopt them."

The majority of the guests were disciples of Aristotle, and only one man came to Galileo's defence. This was the Cardinal Maffeo Barberini himself.

Barberini had a clear mind. He appreciated the niceties of the problem and the fertile and lucid working of Galileo's mind. His admiration for him grew. He was devoted to science and could not but approve the celebrated mathematician's elucidations.

This admiration, coming from one of the heads of the Church, is a very important factor in the understanding of Galileo's later attitude and the birth of the implacable persecutions of which he was the victim. In the meantime he was very grateful to Barberini. He realized that the backing of theologians in matters of science was vitally urgent to his cause.

The present silly quarrel might have degenerated into a free-for-all fight if the Grand Duke had not intervened. In order to quiet things down and bring the matter to a satisfactory conclusion, he asked Galileo to publish the question and all the arguments for and against.

But his impatient opponents did not care to wait that long. One of them, probably Papazzoni, came to Galileo three days after the banquet and asked him to attend another reunion at which there would be a

colleague who had not yet appeared upon the scene. Galileo accepted, and on the given day went to the meeting.

There he waited in vain while his hosts were appearing in the public square armed with basins full of water and balls and tablets of ebony and other woods. They proceeded to experiment in front of the mob like charlatans at a fair, proclaiming their triumph. They made particular fun of the supposed "magnetic force" of the air, which was supposed to keep hollow vessels and leaves of lead on the surface of the water.

A little later Ludovico della Colombe proposed another meeting to Galileo. There he was to be confronted with Don Giovanni de' Medici, his sworn enemy. But this time it was Galileo who did not turn up, either in order to avenge himself for the previous insult or because of Don Giovanni's presence.

It was a wonderful opportunity for Ludovico to announce that the defender of Archimedes had beaten a cowardly retreat because he feared the crushing proofs of the Aristotelians.

In May, 1612 Galileo published his book on the problem of the Immersion of Bodies. It was dedicated to Cosimo II. An answer appeared almost immediately. It was written by Arturo D'Elci, provost of the University of Pisa, under the *nom de plume* of "Unknown Academician".

He reproached Galileo for wishing to usurp Aristotle's throne and found an empire on earth after having tried to establish one in the heavens.

This was answered by Giorgio Coresio, professor of Greek, in the same spirit.

Then, inevitably, it was delle Colombe's turn. He

accused Galileo of trying to revive notions which had long been recognized as false, and of wishing to annihilate Aristotle. He added these significant words: "One would gladly adopt the opinion of Archimedes (whom Galileo defended) if it did not oppose itself to that of Aristotle whose authority is incontestable in physics; whereas Archimedes was only a mathematician."

Mathematics and their application to natural facts was a mental infirmity in the eyes of these obstinate logicians who wanted no real knowledge. That is why Galileo answered them with caustic irony.

He was ill. His mental activities suffered in consequence, and the interminable polemics on the immersion of bodies wasted much of his precious time without adding anything to what Archimedes had said long ago.

Unfortunately Galileo often got mixed up in such endless discussions. They were part of the intellectual life of those days. The controversy regarding the spots on the sun was a different matter. He had shown them to the Cardinal Magini and his guests at Rome. As a matter of fact, he had noted them long before. When the painter Cigoli returned from Rome he told Galileo of a series of observations which had been made by one of his friends as a result of these indications. This meant that their interest was aroused. The news spread everywhere throughout Italy and abroad, until one day it reached the ears of a German Jesuit, Father Scheiner, who heard the report from one of his colleagues.

In January, 1612 three letters under the assumed name of "Appelle" reached Welser. The writer claimed priority in the discovery of the sun spots. Besides

maintaining that he had been the first to observe the spots, the writer had a peculiar method of explaining them. He wished to keep the tradition of the sun's inviolability intact and save it from all adulteration. So he asserted that the spots arose from the interposition of stars between the sun and the earth. Welser sent these letters on to Galileo and begged him as a personal favor to answer them.

In his reply Galileo had no trouble in proving that the spots were contiguous to the sun and moved with it. They made a complete circle during the lunar month and remained a part of the tropical zone. So much for their position. As to their nature, Galileo proved that they were exactly like clouds. They could not be stars because they changed shape and dissolved under observation. Their form was variable and irregular. Galileo's answer was dated May fourth, 1612. Two other letters, also dedicated to Welser, followed on the same subject and were communicated in manuscript form to friends. They were ultimately printed by the Academy dei Lincei.

The dyed-in-the-wool pedants naturally did not give a damn for the supposed sun spots. Cremonino in Padua refused to look at them, probably fearing that he might be convinced. Scheiner remained unknown to everyone, still jealously disguised under the cloak of his pseudonym "Apelle".

Cardinal Barberini, having been informed of Galileo's answer, was delighted to hear that he had taught such a lesson to the representatives of official science. He wrote odes in praise of the satellites of Jupiter and showed himself a loyal supporter and intelligent admirer of Galileo. Still, he could not entirely ignore the conclusions which arose out of these obser-

vations. The sun was proven to be spheric, revolving on its own axis and trailing behind it the mists formed on its surface.

Besides the faithful Benedetto Castelli, who founded a certain method of outlining the sun spots, Sagredo, Paolo Sarpi, Ugualdi, Galileo's loyal Venetian friends, all confirmed his opinion by letter, and Cardinal Barberini was no exception.

Of course in Rome all the celestial discoveries had been duly admired, but nobody sought to understand their place in history and their bearing on science. Barberini, in spite of his outspoken admiration, was fully aware of the ominous trend of Galileo's scientific discoveries and the opposition they raised to the preconceived standards.

It was all the more serious because the Church, upheld by learned men like St. Thomas Aquinas, had adopted the philosophy of Aristotle without sufficiently conforming it to the Holy Scriptures. Incredible as this alliance may seem between the doctrine which supposes the eternity of universal matter and the teachings of Genesis which affirm creation *ex nihilo*, it is none the less true that since St. Thomas the alliance had remained solid and intangible.

Still, Barberini, the great Cardinal and a future sovereign pontiff, went over into Galileo's camp and thus created the incredible possibility of a heretic pope. His superhuman effort to maintain his fundamental faith and not allow his intellectual freedom to influence him in his religious duties, undoubtedly helped to bring about the tragic fate of Galileo.

Chapter XX

DISQUIETING SYMPTOMS

AS LONG as they remained on a philosophic or scientific plane, the discussions did not present any serious danger to the peace of mind of his diverse adversaries. Galileo, although he stood very much alone in the midst of all the turmoil, was quite capable of holding his own among the hosts of enemies who increased with every discovery and with every assault made against scholastic knowledge and innate prejudice.

Regarding the solar spots, he said that they marked the death pangs of the doctrines which had been universally accepted on the mutability of the heavens. So true was this that many of the Aristotelians, having reached the limit of their theological defences, desperately clung to religion in order to combat the innovations.

Were they acting in bad faith in order to try and trap their adversary? Possibly not. They were more probably blinded by bitterly passionate resentment. In any case, they were sincere when they sought to find their defence in the Scriptures.

There was a State Philosophy, that of Aristotle; just as, later, there was to be a State Religion. This philosophy apparently could only be based on the Bible. Therefore it was perfectly normal that when their traditional philosophy was in danger, they should seek

further support from their greatest ally, the Roman Church.

In spite of Galileo's prudence, the news somehow spread that all the celestial discoveries were confirmations of Copernicus' statements. Cisi had already insinuated that this conception did not agree with that of the Bible. Ludovico delle Colombe, the troublemaker, had already managed to find out about the correspondence between Bellarmin and the Jesuits, in spite of the secrecy which governed everything that had to do with the Inquisition.

He probably knew, too, about the Cardinal's anxiety since Galileo's triumph in Rome, and he cleverly put his finger on the vital point of the whole question.

He published a book arguing against the movement of the earth in which he accused Galileists of not only wishing to turn the heavens inside out, as if it were a glove to be taken off and on, but also of giving the lie to the Holy Scriptures wherein many verses testify that the earth is immobile in the center of the universe and the sun revolves around it.

The telescope would have caused greater doubt in his tormented soul had it not been for certain texts which he did not hesitate to misquote. Would the wretched followers of Copernicus dare to resort to a reinterpretation of the Scriptures and an alteration of its meaning? One of the first rules of theology is that when the Bible can be literally interpreted it should not be analyzed. Delle Colombe's arguments, though not completely convincing, were truly diabolic. No one could have found a surer method of adding fuel to the fire.

While men of letters were still discussing secondary questions, secret reunions were being held under the

presidency of the Archbishop of Florence, Alessandro Mazzimedi, in a frantic effort to check the growing evil. This group, which counted among them the Dominican Fathers Lorini and Caccini, were desperately studying the ruin wrought by Galileo's doctrines to those who preferred the deception of the eye, via the telescope, to the sacred word of the Bible.

They tried to convince Lorini and Caccini that it would be well to preach in the very cathedral against these innovations which threatened to set fire to a Europe already smouldering with the heresies of the Lutherans and its various ramifications. It might be the most effective move against the blasphemous insanity of this man who dared to diminish the authority of the Holy Writings which God Himself had inspired through the mouths of His prophets.

The painter Cigoli heard this rumored in Rome. He immediately wrote to Galileo advising him of the steps being taken against him.

But Galileo had never allowed himself to enter into the religious question in connection with his astronomical discoveries. He considered that it was not in his rôle of mathematician to attempt to correlate two orders of ideas which seemed to him to belong in entirely different categories.

But the fire smouldered on, and the symptoms of the future conflagration were innumerable. Once in November, 1512, Galileo heard that Father Lorini intended to preach a sermon on the subject of the lies recently spread by the promoters of a new science. Galileo promptly wrote to Father Lorini asking him for an explanation. He preferred to know what was in store, in order to be able to defend himself. But the Father, although full of zeal, lacked honesty and

courage. He denied that there was any truth in the news, and explained that he had simply said to some personal friends: "The opinion of this Ipernico, so-called, seems opposed to the Divine Scriptures."

The deformation of Copernicus' name shows the insidious ability of this theologian who was an implacable enemy of a doctrine of which he did not understand the first word, but which he believed to be dangerous to the Faith. He was ultimately Galileo's denunciator at the Inquisition.

In the Dominican Monastery of Santa Maria Novella, a certain Atavanti was discussing with a Father Ximenes whether God were sensitive; whether, for instance, he was capable of laughing or crying; a capital point which St. Thomas, their illustrious predecessor, had considered in all seriousness. Father Caccini appeared suddenly from a neighboring cell. Obsessed by Galileo, he thought they must be discussing his doctrines.

Another time, in the same monastery, while the same two priests were discussing the movement of the sun, Father Caccini burst forth again and maintained with forceful arguments that the idea that the sun did not revolve around the earth, but only around its own axis, was a heretic proposition which he intended to denounce from the pulpit.

Father Caccini worked himself up into a great state of exaltation, and, wishing to be a second Savonarola, he convinced himself that he was a heavenly delegate, and that his mission was to enlighten the earth and wipe out the progress of a heresy which was infinitely subtle but no less pernicious.

About the beginning of November, 1614, he at last held forth publicly against the Galileists—mere

mathematicians who dared to write words contrary to the Scriptures and be founders of a heresy which was more monstrous than any which the Church had yet exterminated for the good of souls. The holy rage into which Caccini had worked himself probably made his arguments quite impressive.

The situation was delicate. Galileo still kept silence. It was no longer a question of literary polemics. It had become a vital issue, since theology had ranked itself on the side of the Aristotelians. Matters were further complicated by the fact that Galileo was officially in the service of Florence, a State fundamentally Catholic and traditionally sound.

Rome had not openly intervened as yet, but friends put him on his guard. Nobody could ever foresee the consequences of investigations undertaken by the Inquisition; but everybody knew that this formidable tribunal would never hesitate to condemn even an innocent man, if this condemnation could bring about more power and grandeur for Christianity.

Benedetto Castelli, recently named Professor of Mathematics at Pisa, had barely taken possession of his chair when he was approached by the provost of the University, Arturo D'Elci, "the Unknown Academician" who had taken part in the controversy about the immersion of solid bodies in water. He particularly wanted Castelli not to adopt the theory of the movement of the earth in his lectures. Castelli reassured him, saying that his master Galileo, who had himself never taught this doctrine, had given him the same advice.

While the provost editor was taking his precautions against the contamination of the University, the faithful disciple was watching carefully over the safety of

his adored master and trying to attenuate guilt in the eyes of the world. It was vitally necessary to avoid antagonising the grand-ducal household which was Galileo's strongest trench in the warfare against him.

The Court had moved back to Pisa some time since, and Castelli was invited to attend a luncheon. His joy was great when he saw the favor still shown to Galileo. Among the guests he noted Dr. Boschaia, the physician of the University. The Grand Duchess Christina questioned the doctor regarding the controversies of which the chronicles were full, and about which there was so much comment and discussion in both the religious and literary centers of Tuscany.

The doctor answered that the value of some of Galileo's discoveries could not be denied, but that his assertions regarding the movement of the earth could not be true, since the Holy Scriptures had said the contrary.

Princess Christina, who was intelligent and very discreet, let the matter drop for the moment; but after the meal she invited a few intimates into a room apart and begged them to continue the discussion.

Castelli, the obvious man to answer the Biblical objections, took care to play the part of the modern theologian to whom religious interpretation must conform in a measure to the results of rigorous experiments whenever possible in the realm of nature. His answers, which reflected so faithfully his master's point of view, gained the approval of all present, and Boschaia himself did not dare raise any objection, in view of the obviously favorable attitude of their highnesses.

Informed of this success, Galileo thought that the hour had struck to reveal to the world the thoughts

that he had been keeping secret for more than thirty years. Had he been alone, he might have feared that this aggression would further harm his career; but with the support of his sovereigns behind him, he decided to take his chance and brave the storm.

Chapter XXI

THE SIGNIFICANCE OF THE BIBLE

GALILEO was, above all, a scientist in the modern sense of the word. He was the father of natural or physical science, thanks to which the facts of nature are submitted to a rigorous investigation, the results of which no authorities can deny.

But by birth and education he was deeply Catholic and adhered closely to the precepts of the Roman Church. He practised his religion with fervor, attending services and making pilgrimages. He never doubted the virginity of the Virgin Mary and the incarnation of the Word. He adored God and bowed in awe before Nature.

Every one of his discoveries was an occasion for renewed thanksgiving to the creator of all such miracles. And yet here were the theologists practically accusing him of opposing himself to the Bible. They were violently quoting passages to prove that, contrary to his opinions, the sun *did* turn around the earth.

Galileo, with the encouragement of the ducal family, finally broke his silence and presented his facts. This was the object of the famous letter written to Benedetto Castelli on December twenty-first, 1613—that is to say, a week after the meeting at the grand-ducal palace. In it he protested against the introduction of the Scriptures into scientific discussions.

“But since religion is being dragged into it, it has

become necessary," he went on, "definitely to segregate the two domains, in order to avoid a misunderstanding which is detrimental to both. I grant that the Bible itself can neither lie nor deceive, but its interpreters may do so in many ways. The most serious and most frequent error lies in upholding a literal interpretation of the Word. This often brings about contradictions, blasphemies and even heresies. It is like giving God hands and feet and eyes, or any human quality, such as anger and repentance.

"Since there are propositions in the Scriptures which, taken literally, are absurd, it is necessary for enlightened men to reveal their true sense to those who rise above the common herd, and to explain why those meanings have been couched in misleading terms. . . .

"The Holy Scriptures and Nature both emanate from the Divine Word; one as the expression of the spirit, the other as the faithful execution of the word of God. In order that the majority may understand, the Scriptures often state facts that are far from being absolutely true in the exact sense of the word. Inexorable and immutable Nature, on the contrary, does not worry about whether its mysteries and its emanations conform to human possibilities, and it never transgresses the limits of the laws imposed upon it.

"This being admitted, and it being proven that two truths can never contradict each other, the opinion of wise commentators is that first it is necessary to find the true meaning of texts which correspond to natural conclusions, after having first convinced themselves by means of infinite experience and necessary demonstrations. . . .

"I believe above all that the author of the sacred work has as his only aim the desire to persuade men

of things necessary to their salvation. If the early prophets had wished to convince the people of the disposition and movement of the celestial bodies they would not have spoken of them so cursorily. The mention that they have made of them is practically nil in comparison with the innumerable conclusions which have been reached by astronomy.

"Therefore, consider, most Reverend Father, unless I am mistaken, the disorder with which they proceed who, in scientific disputes which are alien to the Faith, insist on giving a first place to scriptural passages, of which they have often ill grasped the meaning."

Such was Galileo's profession of faith. He believed in the Bible and recognized the authority of the Roman Church in religious and moral matters; but he declared it incapable of solving problems needing observation, calculation and experiment. The result of his reflections and his clear-sighted exposition of them satisfied both his heart and his conscience.

But it was just this very attitude which was intolerable to the religious professionals. To them philosophy, that is to say the totality of human science, was the servant of theology and must therefore needs submit to its authority; the reason being that theology was based on tradition and divine revelation directly inspired by the Holy Spirit and the fathers of the Church. Whereas philosophy was subject to the infirmity of the human mind.

Father Lorini, always carefully remaining in the background and ever protesting his friendship for Galileo, was really the instigator of the plot. Thanks to his hypocritical zeal, he succeeded in obtaining a copy of Galileo's letter a few months later. He quoted the passages most likely to provoke religious frenzy. He

again urged Caccini to speak against Galileo's heresy; not only the heresy which pertained to astronomy, but the far more pernicious heresy which dared question the accepted interpretation of the Holy Scriptures.

What a subject for a sermon! Caccini well knew with what hatred the Church regarded the diabolic tendency inaugurated by Luther of trying to understand the meaning of the Word of God without the intervention of official theology. Never had humanity stood on the brink of so dark and deep an abyss.

Father Caccini's sermon has not been immortalized, therefore the exact words are unknown, but they must have been terrible and devastating judging by the results. Obviously he did not hesitate to distort the facts to such an extent that even Father Luigi Marafi, General of the Convent of Minerva at Rome and a Dominican himself, was profoundly disgusted and apologized to Galileo as if he himself were responsible for the *gaucherie* of one of the members of his religious family. "Unhappily for me," he said, "I am involved in all the stupidities which are apt to be perpetrated by the thirty or forty thousand brothers of my Order." He declared Father Caccini's conduct to be shameful and baseless.

Unfortunately in the eyes of the Church, it was not Marafi, but Caccini who was in the right. He was only doing his duty as ardent upholder of the Catholic Faith. If all the champions of the Church in the sixteenth and seventeenth centuries had been like Marafi there would certainly have been less bloodshed and death by torture and the stake; but Catholicism would have died out and no longer be anything but a historic memory.

Federigo Cesi, Duke of Acquasparta, deplored the

behavior of these enemies of science who took it upon themselves to handicap useful discoveries. He implored Galileo not to let himself be discouraged. The best way to defeat these fanatics was to ignore them. He himself promised to try and undermine this conspiracy.

Galileo did not take his advice. For twenty years he had served his science, and at last had arrived at facts which confirmed the teaching of Copernicus, which he now publicly corroborated. He felt that it was his duty to bring home the seriousness of the problem to the Roman prelates and to answer all objections which were raised against him. So he sent Monsignor Dini a copy of his letter to Castelli, begging him to communicate it to the Jesuit Father Griemberger and to Cardinal Bellarmin.

He added that his enemies were trying to condemn a book without ever having read or understood it. Yet it had been recognized by the Church for seventy years. He pointed out that Copernicus had been both a Catholic and a preacher. Leo X had even chosen him to amend the Ecclesiastical Calendar, and his works on the revolution of the celestial spheres were dedicated to Pope Paul III. "These worthy Dominican brothers, in their sinister enmity against me, are taking pride in rewarding the author of those works by declaring them to be heresies."

Galileo felt sure that the war being made apparently against modern astronomy was really aimed at him personally. Possibly that was true to a certain extent. But it is childish to believe, as did Galileo and most of his biographers, that the Church would espouse private quarrels. Actually it was the eternal fight against all ideas and tendencies capable of belittling the Bible and diminishing the authority of the Church. Galileo suf-

ferred merely as the figurehead of a modern movement which the theologians judged to be of vital menace to Roman Catholicism.

Monsignor Dini, as soon as he received Galileo's message, undertook a secret enquiry among the high ecclesiastical dignitaries. He then answered that the affair was not as serious as Galileo feared. The worst that could happen was that it might be decided to add certain foot-notes to the books of Copernicus in which it would be stated that his doctrines were only meant to save appearances, and that they carried no real weight.

But such foot-notes, which seemed insignificant to Dini, would have meant a step backward for astronomy, subordinating it more than ever to religious belief. Galileo feared this above all else. The hour had come. He was fighting to save science from the grasp of theologians who were unable to realize its import.

"To persuade the world," he answered, "that Copernicus has not truly judged the mobility of the earth is, to my mind, an error which can only find partisans among those who have never read his works. . . .

"In undertaking to reconcile the texts of the Scriptures with the new doctrines it is necessary to have complete knowledge of these doctrines; for it is impossible to tune two strings of a musical instrument while only listening to one."

Chapter XXII

THE CHURCH'S POINT OF VIEW

IN ROME, Cardinal Bellarmin had never ceased watching the development of the heresy which he had foreseen as the certain outcome of Galileo's first revelation of his astronomical discoveries in 1611. It is not improbable that he told his representatives in Florence, under the cloak of the inviolable secrecy of the Inquisition, to report the progress of this modern science and induce its promoters to explain its relation to the Scriptures, and so betray themselves.

It was the custom of the Holy See to encourage and reward such informers, and Bellarmin was not the man to hesitate to use any means at hand when it was a question of defending the interests of the Faith. He had entered the order of Jesuits in his earliest youth and had always bowed before its discipline and espoused its ambitions. The teaching of Loyola, his master, was the ultimate law in his eyes. If authority told you that what seems white is black, then black it must be!

His reputation as a theological student grew rapidly. Pope Sixtus V attached him to the pontifical legation of France. Gregory XIV chose him for the task of expurgating the new edition of the Bible. The sovereign pontiff Clement VIII wrote: "We have chosen a man who has no equal in the Church, either by reason of his virtues or his doctrines."

He was made a member of the Holy See before he was created a Cardinal. His opinion was sought in all difficult cases. In Galileo's time he was the most eminent supporter of the theory of the supernatural origin of power. This power, emanating from the keys conferred on St. Peter, and by him on the Sovereign Pontiff, is supposed to justify Catholic imperialism and the universal dictatorship which Rome allows itself to exercise over princes and peoples. It is also the nominal source of papal infallibility. In Bellarmin's eyes Protestantism of any kind constituted the most monstrous heresy of all, since in defiance of the papal authority it allowed individuals to interpret the Bible according to their own conscience.

All these opinions gave Bellarmin great prestige in the affairs of the Holy See. Unlimited confidence was accorded him by several popes, especially by Paul V who had occupied the papal throne since 1605. It was he who had excommunicated the Venetian Republic.

Born in Siena, Camillo Borghese, named Paul V, had been named Inquisitor to the Supreme Tribunal a year before Bellarmin. He was a theologian and a jurist and had no use for philosophic discussions. Piero Giuccardini wrote to Cosimo II that Paul V "mis-trusted literature and men of wit. He cannot tolerate innovations or subtleties, and his followers are forced to conform their minds and their natures to that of His Holiness. Even men who do know something and have curiosity and intelligence, pretend ignorance in order to avoid suspicion and gain promotion."

It was true that Paul V was neither a *littérateur* nor a scientist. He was an essentially practical man. He loved town life, raised buildings, tried to embellish the Eternal City, and was absorbed by details of ad-

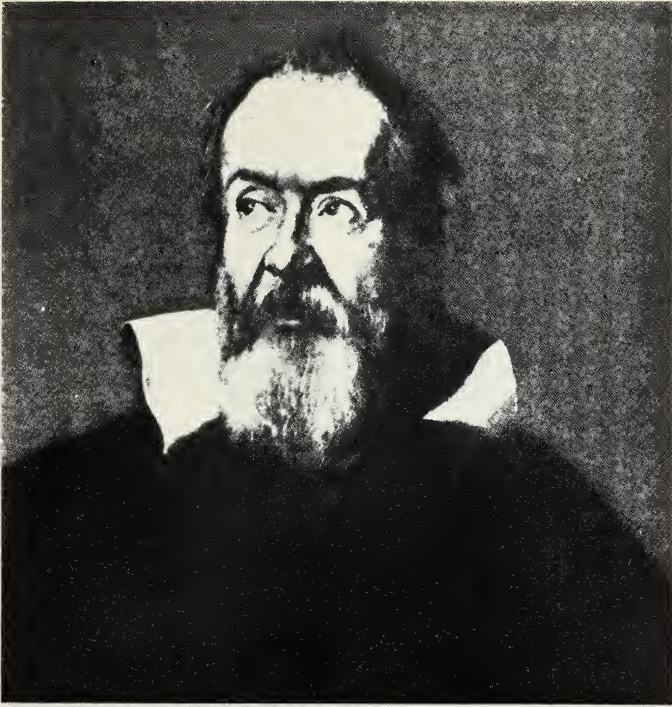
ministration. Obstinate and conscientious, jealous of all sacerdotal authority, careful of the ecclesiastical social order which was the only legitimate one in his eyes, he subordinated everything to his ideal, and when necessity arose, knew how to take strong measures.

He and Bellarmin collaborated for many years, during which they lived through the same anxieties and thought out the same problems. The fact that it was they who, from 1593 to 1600, were the judges in the suit against Giordano Bruno, makes it possible to understand the relentless persecution of Galileo and the vicissitudes of the Copernican system.

During ten years of general indifference Bruno had been the only thinker to uphold the new astronomy. In the absence of the absolute proof made possible by Galileo's inventions, he had had to base his conclusions on intuition and analogy. He went even further than Copernicus, left the stars alone in their ether, broke up the celestial heavens, and affirmed the infinity of the universe and the plurality of the inhabited worlds.

But an infinite universe left no room for the infinity which is called God. Therefore he figured that God and Nature could not be separate and distinct, as taught by Genesis and the Church, but must be two aspects of the same unique force of whom human beings were only the transitory manifestations. He confounded God with Nature and attached his pantheism to the theories of Copernicus.

This philosophy which would render the mysteries of the virginity of Mary, of reincarnation and the mass, meaningless, was of course condemned by the Church as the basis of the most appalling heresy ever uttered. But Bruno refused to recognize his statements as heresies. What had the Scriptures to do with



Deuot.^{us} et Oblig.^{us} ser.

Galileo Galilei

GALILEO IN HIS LATER YEARS.
(As Painted by the Fleming, Justus Sustermans, 1635)

these conceptions, anyway? They were only meant to teach moral law. Let the ignorant take the Bible literally, since they were incapable of thinking things out for themselves. But this mental tyranny was absurd towards thinkers whose mission it was to reason for others, and who were therefore certainly quite capable of reasoning things out without the assistance of theologians.

When questioned about his interpretations of Biblical mysteries, Bruno interpreted the Scriptures freely and gave philosophical explanations which were welcomed by all intelligent men. But since the birth of Protestantism had dealt such a terrible blow to the Church, mental initiative was looked upon as being even more heretical than the aberrations which it engendered.

Giordano Bruno knew that his death was necessary. He went to the stake fully aware of the moral value of his sacrifice. But Galileo's position was different. He was a believing Catholic, and he accepted the divine revelation of the Bible; whereas Bruno only regarded religion from its practical aspect without it touching either his heart or his mind. He was above dogmas, whereas Galileo submitted to them. But only in as far as this submission had to do with the salvation of his soul and did not attempt to qualify his science.

This distinction between Faith and Science is as old as the world. It had been discussed six centuries before by Greek philosophers such as Heraclitus and Xenophanes. But Galileo's attitude was unique and brought an original contribution to the evolution of humanity. Science as conceived by Galileo could not be modified. It was the touchstone of reality for all

mental discipline. Galileo gave science a definite meaning and separated it once for all from all forms of reasoning which were not pure. And this was the distinction which set him apart from all who had preceded him.

But Bellarmin, in collaboration with the future Paul V, had condemned Giordano Bruno, and he knew to what lengths mental reservations regarding the letter of the Scriptures could lead. And he was right. Once permit personal interpretations, it might lead to anything. What Galileo had not actually done his disciples might do. It was therefore urgent to wipe out a movement which threatened danger to the established social order based on the Faith which constitutes the Catholic, Apostolic and Roman Church.

Chapter XXIII

THE DENUNCIATION OF FATHER LORINI

DELATION was the chief method used by the Holy See in their persecution of heresy. Those who denounced usually did so because it ensured protection against excommunication, and indulgences which were supposed to shorten their stay in Purgatory after death. The names of such witnesses were never revealed to the accused, to prevent possible revenge and also in the interest of the Church, because it encouraged zealous Catholics to facilitate the task of the Inquisition.

Father Lorini had lied brazenly both to Galileo and Castelli. He told them that he was not responsible for the dissemination of the facts which lead to the ultimate catastrophe. But it was he who wrote the following damning letter to the Cardinal Inquisitor, Paolo Sfondrati, on February eleventh, 1618.

"Since it is the simple duty of every Christian . . . I believe, I, the most humble of all your most devoted servants, that it is fitting that I should present to you a script that has fallen into my hands. It is published by those who are herein named the Galileists, in which the statement of Copernicus is affirmed: namely that the earth revolves and the heavens remain immovable.

"The Fathers of our pious Monastery of San

Marco assure me that it contains several propositions which seem suspect. For instance, that the Holy Scriptures are full of incorrect statements; that its interpreters expose the facts wrongfully; that it is not right to quote them in connection with anything but articles of Faith; and that in natural questions the philosophic argument has more power than the Sacred or Divine.

"You will find these propositions underlined by me in the exact copy which I enclose. . . . The Galileists wish to explain the Holy Scriptures in their own way and, contrary to the general consent of the Holy Fathers, defend an opinion which is opposed to the Holy Text, and thus undo the entire philosophy of Aristotle, of which scholastic authority has made such great use. . . .

"Finally, I believe the Galileists to be worthy men and excellent Christians, although a little rash and brutal in their opinions. I may add that in making this move I myself am only actuated by zeal, and I implore Your Eminence to keep my secret. It is only an affectionate warning to you as from a servant to a master."

Lorini had progressed. He had learnt how to spell "Copernicus". But he had lost neither his religious zeal, nor his cowardice, nor his falseness.

It is difficult to understand the type of man who lies and behaves vilely out of love for a religion which he considers the embodiment of supreme truth and beauty. It is charitable to assume that they consented to denounce their victims out of sincere piety, as though it were a form of sacrifice to do violence to

their natural sentiments of charity and common decency.

But these men glorified themselves in the name of God without having the courage of their convictions. They brought accusations without even trying to understand the motives of the men they involved; and then they took refuge in cowardly secrecy. It was the quintessence of moral baseness. Mocenigo had betrayed Giordano Bruno. Lorini was the dominating factor in this latest persecution of truth. He must not be judged too harshly. He was the inevitable ex-crescence of that famous institution called the Inquisition which arrogated to itself the rights of God.

Bellarmin only awaited the delation in order to start legal proceedings. On February twenty-fifth, 1615, he assembled the congregation of the Holy Office which took account of the Lorini accusation and Galileo's letter to Benedetto Castelli "containing errors in the meaning and the interpretation of the Holy Scriptures". The Archbishop of Pisa was ordered to try and procure the original of the incriminating letter.

All unaware of this, Galileo was preparing a new defence which he was dedicating to the Grand Duchess Christina. In it he completed the arguments which he had maintained in favor of the system of Copernicus. He spoke about it to Monsignor Gianpoli and Monsignor Dini, who had become a loyal friend, hoping through them to acquaint Barberini and Bellarmin with the falsity of the fatal rumors which were being circulated about him in Florence.

But neither Gianpoli or Dini, though they both held positions in the pontifical court which should have enabled them to know the facts, was aware of the extent to which the proceedings had progressed.

According to Gianpoli the rumors were baseless. Most of the great Romans, even his adversaries, had unanimously bowed before Galileo. Still, it behooved him to be prudent and to submit himself in advance, not only in spirit but also by letter, to the decisions of the Church.

Such was also the advice of Cardinal Barberini, who admired Galileo more than ever. He begged him to remain within the limits of mathematical reasoning and avoid incursions into the Holy Scriptures. "When a man, even a great genius," added Gianpoli, "presents a novelty, he is not always apt to find minds so free of passions that they can accept things as they are. Words which have been spoken by their author are often so deformed when repeated that they are no longer recognizable. And I know what I am saying. You are proving an analogy between the phenomena of the moon and those of the earth. . . . But someone is apt to quote you as having said that there are men in the moon. Others will then begin to dispute about Adam's birth and the building of Noah's ark, and end up by saying a thousand extravagances which have never even entered your mind. Thus, frequent attestations from you to those who have the jurisdiction of human intelligence, through the interpretation of the Scriptures, are very necessary in order to counteract people's malignity."

On March seventh, 1615 Piero Dini sent Bellarmin a copy of a letter of justification which he had received from Galileo, and announced that the latter was preparing a second one. Dini hoped thereby to prove the good faith and religious devotion of his friend. He even had illusions regarding the efficacy of this correspondence when Bellarmin answered that no dis-

THE DENUNCIATION OF FATHER LORINI 183

quieting rumors had reached him regarding the astronomic situation, and that he had heard nothing more about it since Galileo's last visit to Rome.

Cardinal Bellarmin lied, for he had in his possession Lorini's denunciation, and he had himself presided over the congregational meeting on the twenty-fifth of February. His lies were convincing, thanks to years of training. He was forced to lie by profession and by necessity; not because he had any particular love of the art or personal pride in his qualifications as a liar. A solemn oath bound him to absolute secrecy in all matters of the Inquisition. Violation of that oath meant instant punishment, probable death at the stake, and promise of endless torment in hell. To be loyal to that oath it was not enough to pretend ignorance or to be silent when questioned. For a restriction or a silence might possibly betray that there was something to hide. The lying had to be done with artistry capable of putting indiscreet questioners off the track, whether they were friends or brothers. There are no friends or brothers when the reign of God is imperiled. Bellarmin was a finished artist. Having won Dini's confidence, he twisted him round his little finger. He assured him that he would be only too glad to make use of any arguments that Galileo might care to advance.

But in reality he was working feverishly to get his hands on any writings which might throw a light on Galileo's actual attitude towards religious questions. This does not mean that Bellarmin was anxious to condemn Galileo. On the contrary, he had great respect for him. But he also had an eye on the diplomatic relations which might be involved, thanks to the protection afforded Galileo by his sovereigns.

He advised him, through Dini, to treat Copernicus' ideas as pure mathematics. Even if this opinion were interdicted, the liberty and life of its defender might not be endangered. The important thing was to leave the Scriptures alone. Let him leave the safeguarding of the integrity of the Sacred Scriptures, or rather the theologians' interpretation of their contents, to the Church.

How to keep the faith in the Holy Book alive, watch for symptoms of heresy, uphold the absolute authority of the Church and yet save Galileo, was the problem which harassed Bellarmine. Hypocrisy is hardly the word to use in defining the workings of so complex a mind. It would be too simple a solution to so subtle a mental enigma.

So the advice which Galileo received from Dini and from all the prelates who took a sincere interest in his fate, was that he subscribe in advance by word and in action to the exigencies of the Holy Office. No matter what his fault might be—always supposing that he had committed a fault—this anticipatory submission would serve to protect him from all Inquisitorial abuses.

Shortly after the congregation of February twenty-fifth, the Archbishop of Pisa was commanded to obtain the original of the letter denounced by Father Lorini at all costs. The good Archbishop, who was famous neither for his intelligence nor his culture, sent for Castelli. He begged him to abandon "certain extravagant opinions", particularly those regarding the movement of the earth, if he desired his own good and wished to escape ruin, because these opinions were under observation and had been declared dangerous, scandalous, bold and directly contrary to the Holy

Scriptures. As proof of their absurdity he made this enlightened statement: "Since everything that is created is for the service of mankind, it is consequently evident that the earth cannot move like the stars; and if you had had enough wisdom to grasp this fact you could never have thought otherwise."

He said that he had sincerely tried to convince Galileo of the folly of these ideas which would undoubtedly bring about his destruction. But Galileo had not chosen to understand him.

This naïve archbishop had not been told to try and teach Castelli true astronomy according to the Faith, but he did so as part of a definite plan. It was only at the end of the animated discussion that he mentioned the official reason for his convocation.

It would be interesting to know just how he went about asking for the famous letter without betraying that it was an order from the Holy Office and without awaking Castelli's suspicions.

That the whole preliminary discussions were only a way of leading up to this seems proven by the fact that Castelli, who no longer had the letter, went straight to Galileo. He implored him to hasten the completion of the writings which he had planned to send to the Grand Duchess Christina, and to let him give them to the Archbishop. Perhaps they might serve to pacify him. "I say perhaps," insisted Castelli, "without being able to give you absolute assurance."

By this trick the Archbishop showed himself worthy of the traditions of the Inquisition which he represented with such assiduity at Pisa. Not only did he succeed in deceiving Castelli, but he made him an unconscious collaborator of the Holy Office. It was a masterpiece of diplomacy of which he might well be

proud, and which was probably applauded by his masters.

Castelli continued to urge the speedy delivery of the manuscript which was being demanded of him; and he finally placed it in the hands of the Archbishop without suspecting for a single moment that instead of serving Galileo, as he thought, he was thus betraying his revered master.

Chapter XXIV

THE SECRET OF THE GODS

IN ROME Dini and Gianpoli worked with the blind devotion that is unfortunate in every sense of the word. They ran from one cardinal to another desperately trying to get at the truth of the situation in order to let Galileo know what was going on.

Cardinal Maffeo Barberini assured them that he had no knowledge whatever of the source of the rumors. Like Bellarmin, he lied, for he too knew the exact situation. His only concession was to remind Dini that he had warned Galileo to proceed prudently and only as a professor of mathematics, and he repeated that there was nothing to fear so long as Galileo only discussed the system of Copernicus without referring to the Scriptures.

This was the best he could do, torn as he was between the obligations of a priest sworn to silence and his sentiments of friendship and admiration for Galileo. When it was a question of the affairs of the Holy Office, the ecclesiastical princes were different beings. An atmosphere of mystery surrounded everything they did and said. They no longer reacted to human emotions. They became supermen with one objective—namely the extermination of everything which might lead to heresy.

At the Congregation of the Holy Office on March

nineteenth, 1615, the Pope, who was presiding, gave orders that Father Caccini be questioned and urged to make a statement "to relieve his conscience." On April second the completed statement was read aloud and it was decided that a copy should be sent to the Inquisitor of Florence in order to have it witnessed by the persons mentioned therein.

While this order was being carried out in utter secrecy, Galileo was completing his letter to Christina de Lorraine, Grand Duchess of Tuscany. This is the gist of it.

"Under the cover of apparent devotion, the religious brotherhood are invoking the Scriptures wherewith to fight scientific opinions and prove them to be heresies. The Holy Spirit is only meant to teach us the way to heaven, and not the heavenly ways. No one has the right to limit thought and research and thus bar the road to free reflection on natural causation. You say that theology is the queen of all sciences and that its duty consequently is that of putting order in human minds. But this sovereignty does not mean that all sciences are comprised in theology, and therefore better explained by it than by anything else.

"Theology is the reigning power because it treats of the salvation of the soul and therefore dominates all other questions. But it is illegitimate to constrain knowledge and ask it to conform only to theology. It is not a question of a scientist's good will whether he believes or does not believe in what he has seen and the inferences he has drawn. These are truths based on experiment which impose themselves, no matter

what the Bible may say, for its words are adapted to the common opinion of the epoch in which they are uttered, as St. Jerome himself has testified. And in this respect it is difficult to see how the Council of Thirty can forbid anything, except the changing of the meaning of the Scriptures as taught by the Holy Fathers in all questions of Faith and with regard to the Christian doctrine. But the movement and stability of the earth are neither articles of Faith nor of morals."

Galileo knew the risk he ran. But he had the magnificent courage to defend himself in spite of the fact that Federigo Cesi, Duke of Acquasparta, the founder of the Academy of the Lincei, had warned him that in doing so he might only succeed in making himself appear in the wrong. At a moment when thousands of sorcerers and fanatics were being burned by order of the Inquisition, Galileo, by his freedom of speech and thought, proved not only the supremacy of his intelligence but the noble fearlessness of his character.

Two monks, Antonio Foscarini, a Neapolitan Carmelite, and Diego di Zuniga, a Spanish Augustine, had published simultaneously a system of the world and a book of Job, in which they invoked certain passages of the Scriptures in favor of the system of Copernicus, thereby considerably complicating the situation. Father Foscarini, who admired Galileo sincerely, came to Rome himself and promptly started propaganda which, though well intentioned, did more harm than good. He even sent a copy of his work to Cardinal Belarmin, who answered him in these words on April sixteenth, 1516.

"Most Reverend Father,

"Since you ask my opinion, I will give it very briefly, as you have not much time for reading, nor I for writing.

"Firstly, it seems to me that you and Galileo should content yourselves with speaking not positively, but tentatively, as I have always believed Copernicus did himself; because the supposition of the movement of the earth and the immobility of the sun accounts for appearances, seems to me legitimate, is harmless, and suffices for a mathematician. But to wish to affirm that the sun is actually the center of the world and that it revolves only around itself without passing from the Orient to the Occident; and that the earth is situated in the third heaven and turns with great rapidity around the sun, is dangerous teaching and liable to irritate all scholastic philosophers and theologians. It is, above all, harmful to the Holy See, because it implies that the Holy Scriptures lie.

"Secondly, as you know, the Council also forbids the exposition of the Scriptures contrary to the common approval of the Sainted Fathers; and if you will take the trouble to read not only their own, but also modern, comments on Genesis, the Psalms, Ecclesiastes and Joshua, you will find that they agree implicitly with the fact that the sun is in the heavens and turns around the earth with great speed, and that the earth is the immovable center of the world and consequently the point farthest removed from the firmament.

"And now consider with all the wisdom in you, whether the Church can tolerate that anyone

should give the Scriptures a meaning contrary to that of the Holy Fathers and all the Greek and Latin theologians? Do not answer that it is not a question of the Faith, because even though that may be a side issue it has its bearing on the subject. It would be as great a proof of heresy to state that Abraham had not two sons and Jacob twelve, as to say that Christ was not born of a virgin, because the Holy Word affirms both facts by the mouth of its prophets and apostles.

"Thirdly, I say that even if there were a positive proof of the immobility of the sun and the movement of the earth, it would be necessary to proceed with the greatest prudence in the explanation of the sacred texts which would seem opposed to the fact. But I cannot believe in such a proof until it has been shown me; for it is one thing to save appearances and another to destroy them; and in case of doubt the Holy Scriptures should not be questioned.

"I add that he who wrote 'the sun rises and sets and returns to its place' was Solomon, who not only spoke as inspired by God, but was the wisest of all the wise men who were learned in the human sciences and in the knowledge of things created, and whose wisdom was given to him by God.

"(Signed) Cardinal Bellarmin."

This explains the ecclesiastical point of view better than any other commentary. It was also unmistakably an answer to Galileo's letters, especially the one to the Grand Duchess Christina, of which he sent a copy to Rome and the original to Pisa, where, thanks to the

manoeuvres of Castelli, it reached the hands of the Archbishop.

Whether Galileo ever knew the contents of Bellarmin's letter is doubtful, but he told Dini that a profound discouragement possessed him and was causing the depression which was making him ill and preventing his departure for Rome where he hoped to plead the cause of science personally.

"They reproach me," he said, "with interpreting the Scriptures; whereas it is my adversaries who have invoked them as a means of defeating me. They forced me to use their own weapons, and now they are crying scandal."

Dini, who was afraid of involving Galileo in further perils, had not shown Bellarmin the letter to Christina. Bellarmin did not need to see it. All the necessary steps had already been taken. But Dini was unaware of this, and he continued to agitate in his friend's interests.

Galileo was only interested in winning a victory for science. He wanted the famous Inquisitor to know all his arguments. "The facts must be affirmed," he said, "otherwise there is danger of unjustly stifling some scientific verity because it may displease some future theologian. I do not wish anyone to believe that I hold Copernicus' theory to be hypothetical or inexact. In that case it would be better to condemn it than to save it; and I, who have brought light to his discoveries which have been the basis of all my observations, will not be the accomplice of such an iniquity."

Galileo's health was none too good. He saved his strength in order to be fit to travel when the moment seemed propitious.

Dini, full of false hope, encouraged him to under-



IMPRISONED FOR INSISTING THAT THE SUN IS THE
CENTRE OF THE UNIVERSE.

(After the Printing by Robert-Fleury in the Louvre)

take the journey. But weeks and months went by, and only contradictory rumors reached their ears.

During the apparent lull the Holy See was quietly carrying on its meticulous enquiry. Father Ximenes, witness of the early activities of Lorini and Caccini, had been questioned. On November twenty-fifth the Congregation decided to examine Galileo's work on the sun spots, in the hope that it might reveal a clue to his real mental attitude. Nobody really knew what the Holy Office was actually planning. Only Guiccardini, ambassador of Florence to Rome, suspected the impending danger.

On December fifth, 1615 he wrote to Cursio Picchena, secretary of the Grand Duke: "I hear that Galileo is coming here. On the occasion of his first visit to Rome I realized that his doctrines would not appeal to the Holy Office; and Bellarmine also told me that in spite of the respect which was due to their Serene Highnesses of Florence, it might be necessary to throw a clearer light on Galileo's attitude if he stayed on in Rome. I do not know now whether Galileo has changed doctrine or spirit, but in any case Rome is not the place to come and argue about the moon, or, given our century, to bring forth and uphold new doctrines."

This brutal warning came from a man only too used to the underhand methods of the Vatican. But Galileo, who was as poor a politician as he was a good mathematician, simply thought that Guiccardini must be hostile to his projects. This was not so. But naturally the diplomat's point of view was biased by his wish to safeguard the good feeling in existence between the Pope and the house of Medici. He considered political interests of first importance, whereas Galileo

cared for nothing in the world but the liberation of science and the triumph of his astronomical discoveries.

Cosimo II granted Galileo the official authorization to leave. As Mathematician of the Court he was to live at the Villa Medici, which was the royal residence at Rome. Guiccardini's letter, dated December fifth, 1615, must have reached Florence after Galileo had left. Had it arrived in time, the ruler would probably have withdrawn his consent.

However, Galileo wrote to him from Rome on the twelfth of December reassuring him, and saying that his friends had unanimously congratulated him on having undertaken the journey which might possibly clear up all misunderstandings.

Chapter XXV

THE REVERSE SIDE OF THE TRIUMPH

GALILEO felt optimistic during his early days in Rome. He had been well received; his reputation seemed to be intact; his health was improving and he had voiced his sincerity and good faith everywhere.

To all appearances his optimism was justified. His presence in Rome had at least brought his loyalty and devotion to the notice of the Church. He had shown neither obstinacy nor malice in his conversation. Why should he? He was only too anxious to try and explain the scientific propositions which had been declared suspect, and he carefully avoided making any statement that might harm the future prestige of the Church.

He paid innumerable visits; but though he constantly heard rumors, he could get no definite facts. It was not that he was afraid for his own person, but it tormented him to have to be in such uncertainty as to the exact attitude of the Holy Office regarding his supposed offences.

Antonio Quarengo, his former host in Padua, happened to be in Rome. Galileo was pathetically happy to see him again. He was reminded of all the peaceful years he had spent in Venetian territory. Frequent meetings were held in the house of Cesarini, a Roman nobleman.

With fifteen or twenty of the most learned men of

Rome arguing against him, Quarengo writes that Galileo was magnificent. He made astounding speeches in favor of Copernicus, and held his own against all comers. Not only did he disprove the arguments of his adversaries, but he gave facts which they were unable to shake. He may not have succeeded in convincing them of the truth of his opinions, but he certainly must have shown them the futility of their own.

Apart from Quarengo's letters, the only information to be had on the defence and propaganda of Galileo is contained in the letters he himself sent to the Court of Florence. They were written in good faith, but later events prove that unfortunately his optimism was based on illusion. For instance, he believed that his presence in Rome was indispensable. He imagined that he was overcoming all difficulties and refuting all objections. He was undismayed. Given time and the grace of God, he would be able to ally the tempest.

That is what he wrote on January the first, 1616. A week later he wrote again and repeated that really he had been truly inspired to come to Rome. Traps had been laid for him, he said, but in justifying himself as he had done, and as he was continuing to do, he had nothing left to fear. He was sure he had confounded his enemies.

It had even been noised abroad that he had fallen into disgrace with his sovereigns, but this was disproven by the official honors he had received in the ducal palace itself. He jeered at the pretensions of Lorini who had just arrived in Rome, and who found his plot developing according to his hopes.

But a week later Galileo became vaguely perturbed. He said nothing definite, but it was apparent. Perhaps in order to convince himself, he stated that things

were still going well, but that the outcome was hanging fire because he might not negotiate personally with the members of the Holy Office itself without incurring the ultimate rebuke. He found himself obliged to resort to intermediaries in order to ensure his written justifications reaching the tribunal. But he concluded by saying that in spite of the serious accusations made against him, he was sure that he would be able to bring everything to a satisfactory conclusion.

The most important of these intermediaries was the new Cardinal Orsini, closely bound to the Medici and an avowed protector of Galileo, who had no difficulty in winning him over.

Bellarmin had said that he was willing to take the opinions of Copernicus into serious consideration the first time a decisive argument could be given in their favor. Like most wise men of that epoch, Bellarmin did not grasp the fact that in science theory is only valuable in so far as it classifies known facts and paves the way for further discoveries. He demanded absolute proof of the movement of the earth and the immobility of the sun. That he should not realise that this sort of proof was impossible is conceivable. But that Galileo should have actually tried to furnish this irrefutable proof is incredible. He was animated by the hope that even if they were unwilling to make concessions regarding the Holy Scriptures, they might at least spare the doctrines of Copernicus.

He quoted the tides as a peremptory proof of the movement of the earth. He confided this statement to Cardinal Orsini, who approved it and hastened to communicate it to the fathers. But naturally it did not convince them. The fact remained that Galileo

considered Copernicus' opinions a truth and not an hypothesis, and that was the only fact that interested the Holy Office, so Galileo's proof merely precipitated events.

Father Caccini came back to Rome and granted him an audience, asking for the honor of a discussion with him. Galileo took this as a sign of victory. But when he summed up the substance of the interview and the thinness of the objections raised by Caccini, he realized for the first time what was in store.

It was no longer a personal question. His good faith had been recognized in high places, and in his letters he tried to persuade the secretary of the Grand Duke that he had vindicated himself and that now there only remained the need to remove the menace hanging over the book of Copernicus, if that were possible.

He mentioned this casually, as if it had not been the prime reason for his journey and all his efforts. The truth was that he dared not confess his defeat, even to himself. He thought that everything he did was spontaneous; but his writings, his arguments, his visits, were manoeuvred by the agents of the Inquisition without his ever dreaming it.

Inexhaustible in matters pertaining to the Faith, they tried to see into the very soul of their victim in order to take efficacious resolutions in the interest of Catholicism. Galileo unwittingly furnished his mysterious judges with the testimony which they needed in order to condemn an opinion which they considered pernicious.

The ambassador Guiccardini, and the Cardinal del Monte had warned him. Was it simply in order to have escaped alive from the activities of the Holy See,

and what he persisted in calling the plottings of his enemies, that he had given himself so much trouble?

It was an empty victory. He had hoped for so much more and was wounded to the quick. But he was forced to dissimulate in order to prove that so much fatigue and so many battles had not ended in pitiful failure.

Poor Galileo! His hopeless disappointment and infinite sadness must have been apparent to anyone who had the wit to see through his mask of smiles.

Cardinal Orsini, aware of how things were really going, made a last desperate effort. He went before the Sovereign Pontiff, but Paul V, who as usual was in complete agreement with Bellarmin, had long since made up his mind to put an end to these innovations which tended to destroy blind obedience to the dogmas of the Church. He answered Cardinal Orsini in a tone that admitted no argument, that "it would be a good thing to persuade Galileo to abandon his opinions."

The meaning underlying these words was obvious to anyone used to the indirect phraseology of pontifical ultimatums. It really meant that if Galileo did not abandon his opinions, his liberty and even his life would be in peril.

Orsini insisted; a grave mistake, since his insistence was the last straw. The Pope answered drily that the Cardinals of the Holy See would settle the question; and that very same day he convoked Bellarmin and the entire congregation in order to decree that Galileo's opinions were erroneous and heretic.

This is the decree:

"Censure made by the Holy Office of this City, Wednesday, February twenty-fourth, 1616, in the presence of the Theological Fathers:

"The following propositions are to be censured:

"First: *The sun is the center of the world and of the Universe and motionless in all local movement.*

"Unanimously this proposition has been declared stupid and absurd as a philosophy, and formally heretic because it contradicts in express manner sentences in the Holy Scriptures and is contrary to the proper interpretation of those words and the common acceptance and the sense given them by the Holy Fathers and the doctrines of theology.

"Second: *The earth is not the center of the world, nor motionless, but changes its place entirely according to its diurnal movement.*

"Unanimously this proposition is declared false as a philosophy and no less erroneous according to the Faith and the Catholic truth."

Bellarmin was charged by the Holy Office to convoke Galileo and to advise him in the presence of a notary and witnesses to abandon his opinions and, in case of his refusal, to imprison him.

Galileo appeared Friday, March twenty-sixth, at the palace of the Cardinal, who presided over the meeting; and in the presence of the Dominican Father Seghezzi, commissary of the Inquisition, and two secretarial fathers, was informed of his errors and ordered in the name of the Pope and the Holy See to reject them. He was not to adapt them under any form, nor to teach them, nor to defend them either orally or by writing "under threat of persecution."

Galileo, alone with his conscience and with death

in his soul, acquiesced to the order of the ecclesiastical authority and promised to obey. He signed his renunciation and inscribed his name beside those of the witnesses.

On March fifth, 1616, a decree was issued by the Congregation of the Index of which the following is the essential page.

"In order that this opinion of the immobility of the sun and the movement of the earth should no longer be spread in the future to the detriment of Catholic truth, the Congregation has decided to suspend the works of Nicholas Copernicus on the Revolution of the Spheres, and of Diego Zuniga on Job, until further notice; and absolutely to forbid and condemn the book of the Carmelite Father, Paolo Antonio Foscarini, and also to ban all other writings teaching the same doctrine."

Galileo was trying to deceive himself when he wrote to Curzio Piccena the day after the publication of this decree, that he had had nothing to do with this business. He had proven that his intentions were pure and had manifested his respect and his zeal for the Church. The Holy See had not taken any noticed of the accusations made against him. His enemies had failed, as far as he was concerned. They had only succeeded in condemning the books which explicitly upheld the doctrines of Copernicus.

This attitude was strange. But Galileo was ashamed to confess that, after having announced a brilliant success, the affair had not ended with any sort of progress in matters of science or philosophical liberty. Instead it had resulted in a lamentable retrogression, since here was Copernicus being banned seventy years

after his death, and no hope was left him of being able to express new ideas.

The spiritual crisis through which Galileo passed left an eternal mark on his spirit. He was torn between three dominating factors: his Catholic faith, his convictions as a scientist, and his fear for his prestige in the eyes of the Grand Duke.

And this latter was not by any means the least of the three. It was difficult to coordinate these three motives, and in trying to do so Galileo lost his head and made all sorts of provisional decisions while waiting to see clearly into his own heart. He tried to convince himself and the Court of Florence that he was not personally involved in the condemnation, and it was true in so far as that he came away physically immune from the clutches of the Holy See. But Galileo was struck to the very marrow of his being as a scientist and a thinker. To dare proclaim that he was satisfied showed the unconfessed agony of his soul.

In the midst of all this moral confusion the Pope granted him an audience and listened to him sympathetically. He pacified him and assured him that he would not listen to malicious accusations, knowing Galileo's devotion to the Catholic religion and to the Church as he did. This interview with the Sovereign Pontiff was a mark of personal esteem, but it was also a stroke of diplomacy aimed at the Duke of Florence, in whom the Church had always found a precious collaborator.

Galileo hastened to write Cosimo II about this meeting; but the latter, having been advised by his ambassador, feared complications. He begged Galileo to cut short his stay in Rome, since his honor was satis-

fied, and implored him to stop all discussions on the burning subject.

Rumors were rife at Pisa and Florence that Galileo had secretly abjured under the influence of Cardinal Bellarmin, and that he had received salutary penitence. "If this is so," Castelli wrote to him, "you must truly have had Holy reasons." Abjuration is infamous to a Catholic, especially when it is accompanied by sanctions.

Galileo, stirred by all these tales which bore the appearance of truth, went to Bellarmin to beg for a certificate of rehabilitation, which the Cardinal willingly granted him.

It read:

"We, Robert Cardinal Bellarmin, having learned that Galileo Galilei has been calumniated and imputed with having abjured to me, and having for that reason submitted to salutary penitences, herewith testify to the truth and state that the aforesaid Galileo has not abjured any opinions or any doctrines, nor received any salutary penitences of any sort. He has simply been informed of the declaration made by our Pontiff and published by the Sacred Congregation of the Index, according to which the doctrine attributed to Copernicus regarding the movement of the earth around the sun and the immobility of the sun in the center of the universe, is contrary to the Holy Scriptures and is subject neither to defence nor support.

"In faith of which we have written and signed the present in our own hand this day of May twenty-sixth, 1616."

Denial by mutual consent was not to be confounded with legal abjuration.

Nearly three months had passed since the decree of March fifth and Galileo was still in Rome. He was awaiting the arrival of Cardinal Carlo de' Medici, to whom he wished to confide his many anxieties.

But what could he possibly hope from him? The Holy See was a granite wall against which all efforts were powerless, and he should have counted himself lucky to have escaped at all. He had received treatment which was entirely exceptional. But he owed it neither to his qualities, nor to his fame, nor even to the friendship of Cardinals, but solely to his position of mathematician to the Grand Duke. Even with the interests of the Faith at stake it was necessary to pacify the reigning Medici in view of their useful services in matters of the Inquisition.

Even so, Galileo would never have escaped from the terrible sanctions of the Holy Tribunal if he had not shown such sincere and respectful submission, and if his whole life had not been notable for its piety and Catholic fervor.

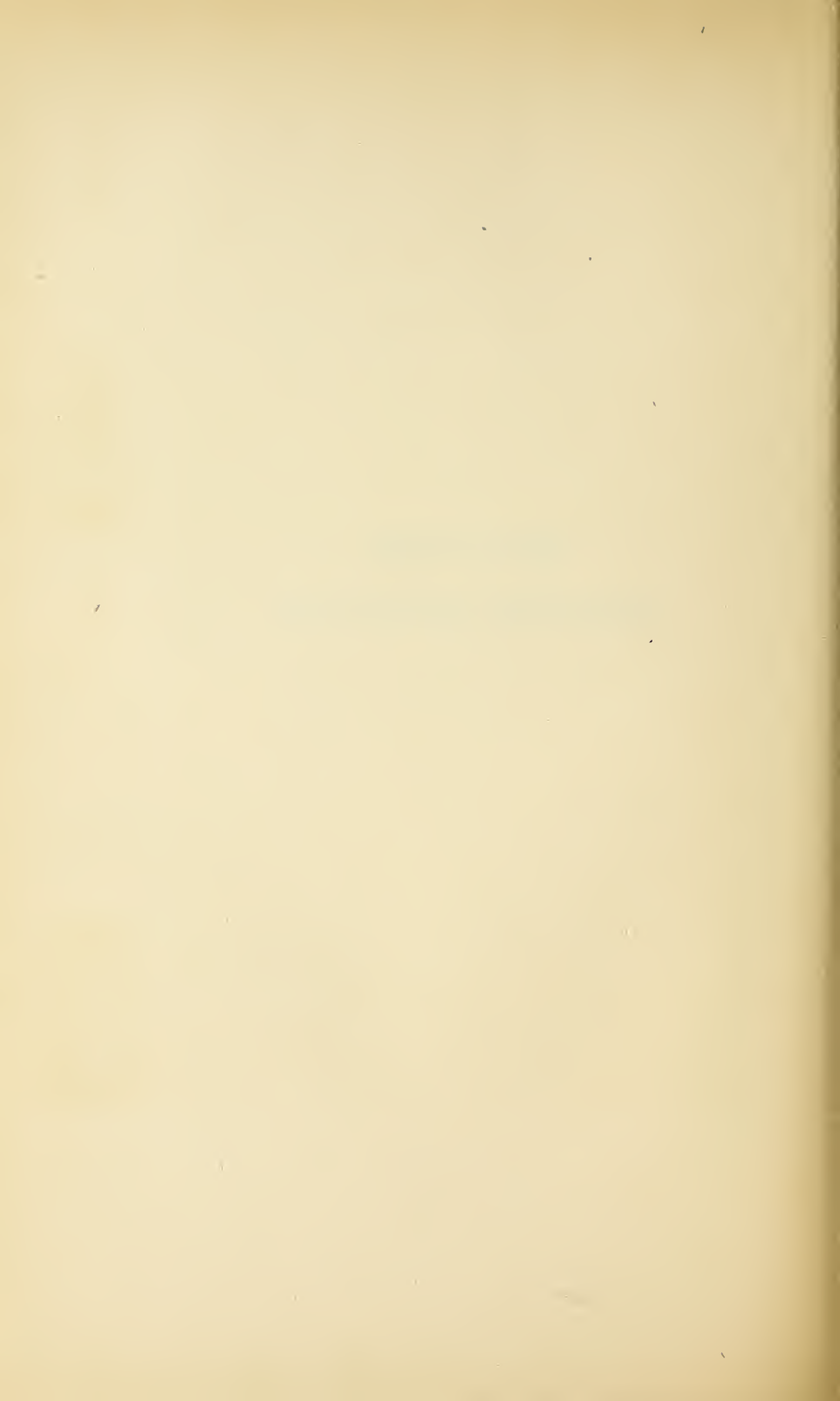
When he returned to Florence in the beginning of June, 1616, his friends rejoiced to see him still at liberty. He was a man who had dared to face the judgment of Rome on the most dangerous questions and had escaped alive. But they realized the brutal setback which science had suffered, and that he who had made himself the champion of that science was wounded beyond healing.

The intentions of the Church were undoubtedly pious, but its methods were unfortunate. They obeyed their instincts of self-preservation by encouraging ignorance. Perhaps Galileo should have protested

against this abuse of power, and died as a hero in the service of science, but men who make great sacrifices in cold blood are not men, they are gods. There have been martyrs, but they are swept away by passion and are lost to reason. Giordana Bruno consented to die at the stake; but he was a mystic and the philosophy for which he gave his life was based neither on experience nor calculation. The Holy See, which constituted itself a sort of committee of public salvation, might forbid the teaching of the new astronomy, but it could not prevent the planets revolving around the sun. Being a believer himself, Galileo had to bow before its intolerant arbitration, but it was a superficial subjugation. He suffered intensely and waited for the moment to come when he might once more voice the creative thoughts which a million church decrees could never destroy.

BOOK FOUR

THE SECOND PERSECUTION



Chapter XXVI

BELLOSGUARDO

SHORTLY after his return from Rome Galileo rented a villa at Bellosguardo which lies about four miles out of Florence. He longed to get away from all the insincerities of court life. The experiences through which he had just passed, the knowledge that the friends who had once fêted him were avoiding him because the shadow of the Holy See had fallen across his life, the bitterness which he felt towards the weakness of the men on whom he had counted—all these things hurt him deeply.

He had a garden which he loved to cultivate himself. He spent hours perfecting his inventions or dreaming of others. There were some which were quite important, but which he never fully developed. He never mentioned them in his works. The fact that they are his can only be gathered from scattered references.

As a matter of fact, it is he who deserves the credit of having found out how to apply dilation of fluids by heat to the reading of the temperature, which is the basic principle of the thermometer. Robert Fludd (1574-1637) brought this invention to light in London without even mentioning Galileo. The latter had thought it out during his stay in Padua.

This instrument had nothing in common with the one now in use. It consisted of a graduated glass tube placed vertically with its open end on a receptacle

containing water. It was closed at the other end by a ball full of air. When the tube was heated the air dilated and compressed the water. When the tube was subjected to cold, the air contracted and the water rose to fill the void. According to this power it was possible to establish a scale of temperatures and make comparative studies.

Giovanni Sagredo, who was very ingenious, had been interested in this instrument for years. He brought it to perfection and created several models. He even noticed that the gradations varied according to the size of the tube, and that in winter the air was often colder than ice, and also that salt added to snow lowered its temperature.

It was also during this period that the conception of the microscope was broached, though it was not completely worked out. The magnifying of the stars was bound to lead to the scrutiny of corpuscles, insects, or any of the atoms imperceptible to the naked eye. By combining a series of concave and convex glasses Galileo achieved the desired result.

His apparatus, such as he described it, bears a distinct relationship to the one which has been universally adopted. The atom under observation was attached to a mobile disc at the base. This could be moved about in order to permit examination from any angle. For the field of vision was conceived in such a way that it only embraced a portion of the object under observation.

Thus, long before Pascal, Galileo knew the infinite grandeur of the sidereal spaces by means of his astronomical telescope, as well as the minute infinity of the tiny objects revealed by the microscope. Perhaps

it also brought home to him the pettiness of human experience.

This period of Galileo's life may have seemed dull, but it was not sterile. He even gives the impression of having set himself various tasks as a sort of test; for instance, the gigantic and ungrateful task of determining the exact position of the Medicean satellites and making out a chart. Kepler and Father Clavio had thought such a work impossible, but Galileo achieved it, thanks to a perseverance of which few men are capable.

His genius in conjunction with his rare common sense enabled him to apply his calculations to the determination of longitudes which until then had only been applied to lunar eclipses, the infrequency of which created great discrepancies in the existent marine charts, and were a great problem to navigators.

The Medicean satellites with their rapid movement around Jupiter brought about eclipses nearly the whole year round and enabled navigators to estimate their positions with fair accuracy and correct the charts already in existence.

Spain, which at this time was the greatest naval power excepting the Netherlands, had promised a magnificent reward to anyone who could discover a method of establishing the exact position of vessels in mid-ocean. Galileo discovered this method. It was of no direct use to the Duke of Florence, who had no fleet, but Galileo offered to give the invention to the King of Spain through diplomatic channels.

This was a desirable courtesy to an eventual ally. The proposal had been made four years earlier, but had remained unanswered. Galileo revived the ques-

tion and offered to go and make the demonstration in person.

But the King of Spain was suspicious of inventors who offered him apparent miracles, and expected him to pay for their journey and the cost of construction as well. How was he to know whether the expense would be justified? His objections were based on the difficulty of using a telescope on a rough sea.

In vain Galileo pointed out that, in the case of storms, a ship was apt not only to lose latitude and longitude but also freight and human souls, and that his solution was only applicable in normal weather.

The King of Spain remained sceptical. The negotiations reopened in June, 1616 and went on until December, 1617, and then fell through. This indifference towards an invention which had cost him so many years of watchful nights did not discourage Galileo, who resigned himself to awaiting a more propitious occasion.

Seven years had gone by since he had left Pisa. His daughters, Virginia and Livia had grown up. One was now sixteen years old, and the other a year younger. They had both been educated in convents, like all young girls of good family. They were very pious, and both decided to enter religious orders.

Their father was too profound a believer himself to refuse his consent. He gave them the traditional dowries. They took their vows at the Convent of San Matteo of Acestri, near Florence; one on October fourth, 1616, assuming the name of Maria Celeste, the other on October twenty-eighth, 1617, under the name of Archangela.

They dedicated themselves to perpetual seclusion.

Sister Maria Celeste, the elder, was very attached to her father, and it was a real sacrifice for her to separate herself from him forever. His visits were her only happiness, but his ill health made them infrequent.

During the year 1618, in spite of a pilgrimage to Notre Dame de Loreto, Galileo went through a very serious illness. Friends came to see him at Bellosguardo and did everything in their power to lighten his burdens. In spite of them he felt very much alone. Deprived of his daughters, he had hoped to find consolation in his son, Vincenzo.

He had sent for the boy after the marriage of Marina Gamba, his former mistress, but Vincenzo did not seem to feel the affection which Galileo craved. He applied for the privilege of legalization for his son, hoping that it might bring them closer together. Cosimo II granted his request by decree on June twenty-fifth, 1619.

Galileo did not believe that he had much longer to live, and perhaps he wished to assure his son an inheritance without legal complications. Vincenzo never showed gratitude for all these attentions. His egotistical nature was not capable of devotion, and Galileo felt lonelier than ever, in spite of his many friends. He longed for someone of his own flesh and blood to show him affection.

Sister Maria Celeste, although unable to leave the convent, was always with him in spirit, sharing his sufferings and joys. She was humble and gentle. Her life was a poem of self-abnegation. Galileo had always been her idol. She admired his genius, although incapable of understanding it. Her few letters are full of the utmost solicitude for her beloved father. She

worried about his health when he returned to Florence. She obtained news of him by every means within her limited power.

"Reassure me," she wrote, "as to your condition, so that if the ill is less than I imagine my soul may be at peace." She looked after his clothes and made him beautiful shirts of finest linen. Her companions gladly shared this labor of love. When the Superior was absent they made Sister Maria Celeste tell them all the exploits of the illustrious astronomer. She received the least mark of confidence from him with the utmost gratitude.

"The haste," she wrote, "with which you let me know and share the honors which you receive from so many people fills me with happiness." She asked him for any letters and books which concerned him, and tried to enter into his life as far as her vows would permit. Never a day went by without hours of fervent prayer to God for the health of his body and soul.

From time to time she sent him emblems of the cult, sacred images, anything that might bring him happiness. She asked for little from him; only a new breviary because the old one was torn. She liked neither gilding nor luxury, she said. What she wanted was clear print and large lettering in order to be able to use it even when she grew old. Her whole life was filled with gentleness and selflessness, and the earnestness and concentration of her love for Galileo was one of the only comforts he knew during his stay at Bellosguardo.

Chapter XXVII

IL SAGGIATORE

IN THE month of August, 1618 three comets appeared in the sky. The most important one was visible until January, 1619.

Astrologers and philosophers had always considered that such appearances foreshadowed events which were of moment to kings, princes and popes. They might even be the precursors of a new religion. They were aristocratic stars which disdained the common mob and were only disquieting to the great of the earth. Nero's crimes were attributed to their influence. A Greek historian of the second century tells us of a comet which appeared in the skies before the death of Vespasian.

During the reign of Louis I, the Debonaire, in 837, a comet very much like Halley's suddenly became visible. A chronicler of the epoch says: "In the middle of the Holy Easter festival a phenomenon of sinister and of dire foreboding appeared in the heavens. From the moment that the emperor, always very attentive to such facts, perceived it, he took no more rest. A change of government and the death of a prince were always announced by a comet. In spite of his prayers, his offerings to the monasteries, and the churches which he caused to be erected in all haste, he could not ward off his destiny."

Three years after the fall of Constantinople in

1456, another comet appeared. The Mussulmans said it was shaped like a cross, but the Christians insisted that it was more like a scimitar. In order to avert the impending danger, the Pope, Calixtus III, caused the bells to be rung in all the churches every day at noon. The Angelus which still calls the faithful to prayer dates from this moment.

In the sixteenth century famous men like Ambrose Paré, the great surgeon, described the comet of 1528 with terror. "This comet was so horrible and so terrifying, and engendered such fear among the masses, that some of them died of fright. Others fell ill. It was excessively long and the color of blood. At its summit a curved arm could be clearly seen holding a great sword in the hand as if ready to strike. At its extremity were three stars. On both sides of the rays of this comet could be seen innumerable blood-colored hatchets and knives and swords, among which appeared hideous human faces with flowing beards and hair on end."

Imagination, inspired by fear, perceived monstrosities of the same sort in the comets of 1577 and 1618. The actual comet of 1618 was naturally the object of fantastic interpretations by astrologers and divines.

There was great excitement about them. In Rome, at the Jesuits' College, Father Grassi held an open discussion on the subject. It was followed by the publication of a book. He upheld the theory of Tycho Brahe that comets, luminous in themselves, follow an immense trajectory, which proves that they are situated in the firmament with the other stars and that they share their destiny. That is to say, they do not magnify when observed through the telescope. This

thesis created much excitement in Rome where it was considered as having given the lie to Copernicus.

But Galileo was ill again and had not been able to watch the comets. Still, he might have given the opinion so ardently sought by his followers if the profound disappointment caused by the interdiction of 1616 had not broken his spirit for the moment. He could not bring himself to believe that Copernicus had really been condemned eighty years after the publication of his works. His bitterness was the outer sign of the unhealed moral wound which sapped the vitality of his mind more than any mere physical suffering had ever done.

Leopold of Austria, whose sister had married the Grand Duke of Tuscany, arrived in Florence at the moment of the excitement about the comets. Wishing to meet the illustrious astronomer personally he went to visit him on his sick bed at Bellosguardo. He talked to him for a long time and made him promise to intervene in the discussion which was creating such an uproar. Galileo, who was in no condition either to observe or write, gave his impressions verbally as a simple hypothesis. Even if it were not a satisfactory solution to the problem, it seemed to annihilate Grassi's contentions.

Galileo pointed out that the comets had trajectories which distinguished them from both the planets and the fixed stars. Noting that the comets were transparent and that their tails were always turned in the opposite direction to the sun, he explained them as phenomena rather in the character of rainbows or the aurora borealis, and attributed their light to the reflections of the sun on vapors or any such aerial condition. But he added that this was only a supposition

which observation and experiment alone could determine.

Mario Guiducci, a disciple of Galileo's, in a famous lecture at the Academy of Florence, expounded the two elements of the problem; the thesis of Father Grassi and Galileo's opinion, which he shared. This lecture was published early in 1619 by Pietro Cecconcelli who kept a shop, significantly called "To The Medicean Stars."

Cardinal Maffeo Barberini, who eagerly read any work of Galileo's that appeared, received Guiducci's exposition with pleased interest; but Father Grassi and the Jesuits of the Roman College did not find it at all to their liking. They were offended by the opposition raised against them, and said that Galileo showed ingratitude for the honors that they had publicly rendered him.

In October of the same year an answer appeared under the title of "Astronomic and Philosophic Balance." It was signed Lothario Sasi Sigenzano. This pseudonym might have been intriguing to some and disquieting to others if Father Grassi had not whispered everywhere that he was the author of the work to which, by the way, the Jesuits themselves took exception.

In it "Lothario Sasi" called himself a pupil of Grassi. He said that it was his duty to point out the errors of his master's adversaries because it would be too undignified for Grassi to do such petty work himself. He called Guiducci a mere copyist and triumphantly refuted all the arguments made for the good of the cause. He reproached Galileo with lacking gratitude to the Jesuit fathers, for had he not failed to note the beautiful poetical images contained in the

writings of Grassi? He finally asked this insidious question: "In order to please Galileo, is it necessary to follow Copernicus who has been condemned by the Church?"

The Lincei were considerably disturbed. They decided that Galileo must write a refutation in the form of a letter to Virginio Cesarini, in which he must pretend not to know the real author of the libel. This would give him more freedom in his attack. He must seem to be interceding on behalf of Father Grassi and his colleagues of the college.

Owing to Galileo's frequent attacks of rheumatism, and all sort of troubles and delays in the printing, the book did not appear before the year 1623. In the meantime the interested parties waited anxiously.

Every day fresh arguments were raised against one side or the other. The Jesuits were uneasy and asked to be allowed to read a few pages of the manuscript, but the members of the Academy had undertaken the printing and were not going to place such weapons in the enemies' hands before having obtained the permit to print. They meant to avoid obstacles being put in their path by the Roman College, which had a governing vote in all affairs of the Vatican.

In order to be able to give his book the title of "Astronomic Balance" (meaning also the balance in the weight of arguments) Grassi had placed the comet in the constellation of the "Balance," and thus achieved a pun which he thought was funny. In his answer entitled "Il Saggiatore," Galileo pointed out that the comet was in "Scorpion," and the play on words was therefore meaningless. Given the true situation of the comet, Grassi ought to have called his work "The Philosophic and Astronomical Scorpion,"

which would have been a better indication of its true spirit.

"You reproach me with ingratitude towards the Jesuits," Galileo wrote. "Just what do you mean by that? Because they have testified to the truth of my observations of which they were convinced, am I in turn to testify, out of gratitude, to that which I believe to be untrue? As for Copernicus, whom you impute to me as though he were a crime, he never wrote on the subject of the comets. You might just as well have quoted a Greek dramatist. Science is inscribed in a great book which is ever open before us and which we call Nature. No authority can prevail against the facts of observation; and in order to interpret them, only the language of physical laws, in other words mathematics and geometry, can be used."

The work had not yet appeared in the libraries when an event of great consequence took place which gave a new and unexpected turn to the story. Maffeo Barberini was created Pope.

Chapter XXVIII

URBAN VIII AND GALILEO

AT THE end of the year 1622 an apologia appeared in the libraries in favor of Galileo, edited by a man inured to fighting and suffering. He was a Dominican Father named Campanella who had lain since 1599 in the subterranean dungeons of Naples after condemnation by the Holy See. He had been tortured four times. Nobody knew how he had ever escaped the stake. This apologia had been written at the moment of the controversy in Florence regarding the relationship between the Scriptures and Science, and Campanella had confided it to a friend who had published it in Germany.

Unfortunately it appeared too late. The authorities condemned it and repressed the sale. In 1623 Pope Gregory XV, who had succeeded Paul V, died. The Conclave met for the election of a new pope, but the heat was so great that several of them died of congestion, therefore the deliberations and formalities were not as elaborate as usual.

The only man capable of facing the difficulties of the hour and reviving the dying church was Cardinal Maffeo Barberini, Galileo's friend and disciple, and he was unanimously elected. There is a superstition to the effect that bees swarmed through the windows of his palace, advance messengers miraculously sent by heaven to bring him the news.

"Although the voters had entire freedom because of the secrecy of the methods employed," says the History of Conclaves, "they were so inspired by the Holy Ghost that they agreed without a dissenting voice that Barberini was the only possible Pope. His gentleness, his sincerity, the integrity of his morals, his profound erudition and the assiduity with which he had applied himself since his youth to the fulfilment of the services entrusted to him, were sole reasons for his election. He was worthy of this supreme dignity."

Maffeo Barberini took the name of Urban VIII. Both intellectuals and the ministers of the Church themselves were delighted with the result of the vote. Stelluti, member of the Academy of the Lincei, wrote to Galileo on August twelfth, 1623: "The election of the new Sovereign Pontiff has filled us all with joy because of his many great qualities. He is a protector of literature and an incomparable patron of all the arts." He also told Galileo of the steps that had already been taken in favor of science.

Urban VIII, product of an age of nepotism, promptly made high dignitaries of his relatives and his friends. The post of Maestro di Camera was given to Virgilio Cesarini, the very man to whom Galileo had dedicated the "Saggiatore." The new Cameriere Segreto was Monsignor Gianpoli, a friend entirely devoted to Galileo's interests.

The printing of the "Saggiatore" was just nearing completion. The Academy of the Lincei decided to dedicate the work to the new Pope as a sign of its appreciation. The frontispiece bore the arms of Urban VIII and those of the Lincei, and two statues were reproduced in it personifying Philosophy and Mathe-

matics. Thus a series of totally unforeseen circumstances helped Galileo's position considerably.

It looked as though fate had decided to give him every possible chance of success. Francesco Barberini, Premier Cardinal and a nephew of the Pope, accepted the ring of the Lincei and became the official protector of the society, which presented him with ten works written by members, of which two were by Galileo. The Pope graciously received Federigo Cesi, the founder and president of the famous Academy. He spoke of Galileo, and, after expressing his wish to see him again, voiced his admiration, his esteem and his affection for the scientist.

Cesi immediately informed Galileo of the Pope's interest and urged him to leave for Rome at once, but begged him to stop on his way at Acquasparta for a few days in order to discuss the possibility of approaching the Pope with a request for a suppression of the decree of 1616 condemning Copernicus' system.

Urban VIII, being the friend of all philosophers and scientists, and having always taken Galileo's part, would surely never tolerate the survival of such a decree? This hope seemed justifiable; for the only man who might have put an obstacle in their way was Cardinal Bellarmine, and he had died two years earlier.

On October twenty-eighth the "Saggiatore" was finished. The Pope was the first to receive a copy. He liked having it read loud to him at meal-time and enjoyed its wit and brilliance. Cesarini and Gianpoli were extremely happy over this proof of his interest. Urban VIII always seemed eager to discuss Galileo's works, and though he did not mention it again, it was obvious that the scientist's promised visit would gratify him. The homage of such a genius meant more to

him than that of emperors and kings. Not only the Pope, but all the powerful men grouped about him, awaited Galileo's arrival with impatience.

The vigilant Jesuits did not fail to note their Pope's attitude. Galileo was the man of the hour. It might be wiser not to attack him further for the moment. So Father Grassi curried favor with Mario Guiducci, who happened to be in Rome, and sought reconciliation, intimating everywhere that he too was anxiously awaiting Galileo.

But Guiducci saw through him and advised Galileo not to go near Grassi who was only seeking an opportunity to cry victory.

At last at the beginning of January, 1624, everything was ready for Galileo's departure. The Grand Duchess Christina gave him an introduction to Cardinal Carlo de' Medici, adding, "he does not need an introduction to you, since you know him as well as we do and honor him with your good will."

But in January Galileo was taken with violent pains and fever. The weather was vile. The journey was out of the question until it improved. A month later he was once more on the point of departure with a letter from the Grand Duke Ferdinand II, the son and successor of Cosimo, to his ambassador in Rome. Again illness delayed him.

When the spring came he regained his strength and courage and decided to spend Easter at Acquasparta with Cesi before going on to Rome.

Everything went well as far as Perugia, but once there his driver abandoned him, having found a richer client. Being unable to find another carriage Galileo had to spend Easter all alone. Prince Cesi heard of his

dilemma and sent him his own chair from Acquasparta.

Despite this setback he managed to spend a fortnight with the prince discussing the burning question of the decree. He arrived in Rome April twenty-third towards evening and was promptly presented by the Cardinal Carlo de' Medici to the Sovereign Pontiff, with whom he had an hour's talk.

This meeting between a cultured pope and a representative of science, who was also a sincere Catholic, was momentous. They were supposed to have discussed Copernicus, but as a matter of fact nobody actually knows the subject of their conversation. It was probably merely the renewing of a contact which promised to bring about a closer relationship and a more intelligent collaboration between science and religion.

After the Pope, it was the turn of the Cardinals, headed by Francesco Barberini, to receive him. But Galileo suddenly realized he was getting old. He was sixty; he felt the effects of all this travelling. He longed to retire to his villa at Bellosguardo and finish his various works in peace before he died.

One day while dining with Cardinal Santa Susanna, the librarian of the Vatican, he touched on a question which preoccupied him. It seemed that the Cardinal Zollern, who apparently took an interest in his activities, had promised to confer with the Pope regarding them. Galileo wanted to find out whether all these mysterious theologians could possibly be sincere when they showered a man with honors and yet abandoned at the first sign of danger.

Another time he brought up the same question before Father Nicolo Ricciardi, commonly known as Fa-

ther "Monster." This nickname had been given him by the King of Spain on account of his excessive obesity. He occupied a post of importance at the Vatican and later became Master of the Sacred Palace. It was thanks to his favorable report that the publication of the "Saggiatore" had been authorised. He was a gentle soul, but lacking in character and easily dominated. His sister, Catherine Ricciardi, who had married the Ambassador Niccolini, exercised a great influence over him. But he knew his business, and he advised Galileo to let sleeping dogs lie.

A sinister person was present at this interview. His name was Gaspar Scioppus. He was a literary adventurer and a converted Protestant in good standing at the Vatican, and he had been an eyewitness at the burning of Giordano Bruno whose memory he tried to sully because he was incapable of appreciating the quality of such a sacrifice. He was also a fanatical and hypocritical defender of the Roman power which he flattered for what he could get out of it.

Was he going to exploit Galileo's secret and deal him the blow of his customary treachery? In any case his presence boded ill. The Father "Monster" believed that the movement of the stars was regulated by the angels, and Galileo had a definite impression that he sided with Scioppus.

Cardinal Zollern was granted his audience with the Pope that same week. The Pontiff is said to have stated that the Church had not condemned the opinions of Copernicus as heresy, but only as being too daring, and that he did not believe in any case that the truth could ever be proven to everybody's absolute satisfaction. These rather enigmatic remarks showed the Pope to be torn between religious and sci-

entific scepticism, and gave no indication of his later attitude.

All this was very vague and unsatisfactory. The only definite impression Galileo gathered was that it would be wise to proceed very carefully. To try and reconcile the Scriptures with science was hopeless, but it might be possible to a certain extent to resurrect the question which had been silenced in 1616. Only he realized that the negotiations would drag along for some time before any result could be achieved. The Roman Court had too many political preoccupations to have much time to spare for questions of this sort.

Whatever the outcome was to be, Urban VIII certainly received him several times and loaded him with honors, gave him presents and promised him a prebendary for his son, Vincenzo. At the moment of farewell he wrote an extremely flattering recommendation to Ferdinand II, the Grand Duke of Florence, on Galileo's behalf. "We love with paternal affection this illustrious man whose fame spreads in the heavens and on the earth, because we recognize him not only as a glory to literature but also as a profoundly pious man, both of which give him right to the sympathy of a sovereign and pontiff."

It is true that the secretary who wrote the letter was none other than Monsignor Gianpoli, Galileo's faithful disciple. This piously devoted friend put into it all his tenderness and his overwhelming admiration for Galileo, but the Pope read it and did not change a word of it. Absolute proof of the deference and attachment which he felt for Galileo.

Chapter XXIX

THE FIRST EFFORTS

WHILE Galileo had been defending his discoveries in Rome in 1615, he had a discussion with Francesco Ingoli, secretary of the Congregation of Propaganda of the Faith. The outcome was that this latter wrote out the objections held by general opinion.

Firstly, from everywhere man sees but half the sky, secondly, the heavier bodies occupy lower regions; thirdly, as had been shown by Cardinal Bellarmine, hell, which is the centre of the earth, must be very far from the heavens; fourthly, in expounding the Scriptures the literal meaning must be maintained.

After the famous condemnation of the system of Copernicus Galileo had not been permitted to answer this publicly, but on his return to Florence early in June 1624, he took Ingoli's statements as a pretext and wrote an answer which was integrally the same as that which he had conceived eight years earlier, as the spirit of neither theologians nor philosophers had changed.

In it he limited the problem to the physical and mathematical points of view and adopted the precautions advised by Father "Monster" in order to allay suspicion. He did not undertake this work, he stated, in order to prove the truth of opinions which had been rejected by the superior authorities, but in order to prove to the Lutherans that the Catholics did

not ignore the facts which could be evoked in favor of this hypothesis; only they preferred to subordinate natural observations and proofs to the teachings of the Scriptures.

It was the classic method of concealment employed by free thinkers of the Renaissance to deceive the Inquisition which was eternally spying upon them. Galileo's arguments were intended to show that the earth, having the same character and being of the same nature as the other planets, must, like them, follow an orbit around the sun, and that, thanks to this explanation, the difficulties inherent in the ancient astronomy could be solved. In conclusion he announced the early completion of a far more comprehensive work in which these problems would be solved once and for all.

In Rome Father Grassi had managed to get in touch with Guiducci, thanks to the latter's illness. During the meeting the Jesuit made no allusions to past quarrels, but spoke of his admiration for Galileo and of how excellent he considered his treatises on the ebb and flow of the sea.

This was the opening wedge with which to raise the question of the movement of the earth. Guiducci, who mistrusted the man, pointed out that this was only a hypothesis in Galileo's eyes and not an established principle. His questioner replied immediately that it would be perfectly simple to uphold the new astronomy and modify the meaning of the Scriptures on the day that certain proof could be given of the system of Copernicus. Cardinal Bellarmine had said so.

What was the ulterior motive for Father Grassi's suddenly effusive friendship? The Jesuits knew all the subtleties of their vocation and did not ignore the fact that Galileo's backsliding might bring about serious

consequences for him. Grassi's suggestion was suspect, but Galileo fell into the trap. He wrote to Cesi that Father Grassi had become a devoted friend and that he no longer repudiated the theory of the movement of the earth. He had shown himself to be a sincere partisan and had overcome Galileo's last scruples.

"The Answer to Ingoli" came to Rome. Gianpoli saw it and modified several phrases which might unnecessarily compromise its author. On hearing about this polemic, the Pope, it is said, reproached the Secretary of the Congregation for having entered a domain of which he was ignorant, thereby risking the creation of a moral prejudice against the Association of which he was a member.

On the other hand, a new book by Ciaramonte, a famous physician who was strongly opposed to Kepler, was announced. Galileo wanted to know all its points before publishing his own work which, as a matter of fact, never was printed. Still, this effort was not wholly sterile since the Pope not only raised no opposition but even seemed to enjoy reading the scientist's "Answer."

Thus encouraged, Galileo carried out his project for a dialogue which was to contain a complete summary of all the reasons for and against the new astronomy. He worked on it for years. His friends kept him at it and tried to be patient.

In July, 1627, after three years of waiting, Gianpoli implored him to bring out at least a few chapters and not to give up since he owed the dialogue to Science, to his friends and to himself. The task was a great one. Galileo suffered constantly from physical pain which kept him from concentrating or writing.

At this moment his brother, Michaelangelo, who

lived in Munich, was at his wits' end for money and asked for help. Galileo invited him to come to Italy with his entire family and live with him at Bellosguardo.

It was no small matter to bring a wife and three children and a servant from such a distance. Two baskets hung on either side of a horse or a mule was considered best adapted for the transportation of women and children on a long journey. Traveling partly in this primitive way, and partly by carriage and boat, it took them nearly a month to cover the distance.

Florentine houses were usually big enough to accommodate any number of guests, but by the time his brother's family was installed there was not much room to spare. Poor Galileo, sick and old, who had suffered from too much loneliness and silence, suddenly found himself in bedlam. He did not get along well with Michaelangelo, who had hoped that his illustrious brother would give him a pension and other advantages which were not forthcoming. Relations became so strained between them that Michaelangelo, exasperated, decided to return with one of his daughters to Munich where he had a small property, leaving behind him his wife, Chiaria, his two younger children and the servant. The family lived on at Galileo's expense for quite some time. It is only just to add that Chiaria took good care of him when he was ill.

In March, 1628, his life seemed to be in actual danger. Michaelangelo was worried, but chiefly because of the inheritance. In the midst of this desolation Sister Maria Celeste sent the comfort of her love from her convent. Galileo's son was studying the law at Pisa. He did not bother about his father so long as

he was kept in funds. His sister, Maria Celeste, was deeply hurt by his indifference.

In June 1628 the boy won his civil and canonical diploma and, according to custom, swore the oath of fidelity to the Holy Roman Church. A short time afterwards he wished to marry Sestilia, daughter of Carlo Boccineri, a noble attached to the Court of Florence. She only brought him seven hundred écus in dowry. Obviously Galileo would have to support the young couple.

The marriage took place at Prato. Sister Maria Celeste was of course unable to assist at this fête because of her vows, but at least she had the comfort of becoming acquainted with Sestilia, who came to see her.

She saw to her infinite relief that the girl felt the most tender and respectful affection for her father-in-law. Maria Celeste's prayers were granted. Her father would at last have someone near him who would surround him with care and kindness and facilitate his work in his old age.

Chapter XXX

THE MYSTERY OF THE IMPRIMATUR

THANKS to the changed attitude towards him, Galileo's mind was free to get back to his famous *Dialogue* which he had not touched for three years. He told his friends that if nothing interfered he would be able to finish it fairly soon.

His disciple, Benedetto Castelli, who was teaching in Rome, urged him to persist, pointing out that the Master of the Holy Palace, Ricciardi, was on his side and would probably be able to procure him the Imprimatur, which is the official permit to print. He had also heard that in an interview with the philosopher Campanella, Urban VIII, who had saved him from prison, had said regarding the condemnation of Copernicus: "This has never been our intention, and if it had been in our hands this decree would never have been promulgated."

Galileo worked on his great book with the hope actually in view of making known to the world all the arguments in favor of the old and new astronomy which would enable men of intelligence to adopt the point of view which conformed most nearly to the given facts.

In the Spring of the following year Galileo completed the work. In order to obtain the authorization to print he had to present himself personally at the Vatican. His friends awaited him. Monsignor Gianpoli

offered him hospitality. The Grand Duke put a carriage at his disposal and gave him a letter to his ambassador, Francesco Niccolini. The latter, quite unaware of Galileo's plans, was unprepared for his arrival. He was delighted to see him and only regretted not having had the time to prepare a reception worthy of a celebrity whose friendship he so treasured.

Galileo immediately began taking the necessary steps, aided by his friends, among whom Catherine Ricciardi, sister of Father "Monster," was the most influential. Father Visconti, the collaborator of Father "Monster" was notified and arranged a meeting at a monastery in order to examine the book in the presence of a counsellor.

The intermediary was Father Morandi, general of the religious order of Vallombrosa. Some weeks later this same man was accused of necromancy and ultimately died in prison where he was said to have been poisoned by over-zealous guardians. Father Visconti himself was compromised in the same affair. All this shows that the men who were to be the censors of Galileo's works were not personally opposed to its publication.

After a few corrections, which were more a matter of form than of contradiction, they confided the manuscript to the Master of the Vatican, having carefully pointed out the chapters which were in question. The Father "Monster" told the Pope the results of the investigation and gave him to understand that Galileo was presenting both sides of the astronomical question with impartiality.

Urban VIII was too preoccupied at this moment with European wars, with fights against the Protestants, and with all sorts of complications to find time to ex-

amine the manuscript personally. So he recommended that the publication be authorised, but only if it conformed to the following conditions:

Firstly, Copernicus' system was to be treated as a simple hypothesis, a sort of mathematical caprice. Secondly, the title proposed by Galileo ("Ebb And Flow") must not be used, as it sounded too much like a decisive physical illustration. A refutation of this proof was to be given at the end. Thirdly, it must be declared in the preface that the author recognised the decree which had condemned the new astronomy, not through ignorance of the theories of Copernicus, but as a voluntary conscious submission to the enlightened decisions of the Church and the teaching of the Bible.

In spite of the illusions of Galileo and his partisans it is not so very astonishing that Urban VIII should raise an obstacle. He had always been a staunch friend of science, but being a Pope he could not annul the decrees which had been issued during the reign of his predecessor without risking the overthrow of the ecclesiastical authority of which he was the supreme representative. Also it was necessary for him to foresee the consequences entailed by innovations, and he dared not forget that they served as weapons against certain passages of the Scriptures, thereby encouraging the open interpretation so pernicious to the Faith. The history of the Reformation had been a painful proof of this.

The religious point of view naturally dominated the scientific question in this spiritual leader who was otherwise so intelligent and so modern. It seems incredible that a condition of mental slavery could have existed in which free thought was completely stifled,

but it must be taken into consideration that Catholicism was a social order and that faith and submission to the Church were the passwords. Anybody who questioned was beyond the pale. It was the tragic destiny of inventors to be sacrificed by the society which it had outraged by breaking its rules. They might arouse admiration and gratitude, but the Church could not tolerate them without committing suicide. From its own point of view it was right.

After having given his instructions, the Pope left the responsibility of the Imprimatur to Father "Monster" who decided that it would be wiser to examine the work in detail in spite of Father Visconti's favorable report. But Galileo did not want to stay in Rome indefinitely, so he protested.

Thanks to the powerful influences backing him, he succeeded in obtaining a provisional permit which enabled him to come to an agreement with his publisher and with the Grand Duke. In exchange he gave his word that he would submit his work to the censor again at the actual moment of publication.

It was Prince Cesi who had undertaken to meet the expenses of the book. He busied himself with the details as soon as Galileo had given him the manuscript with the amendments which the revisers had demanded, and also those suggested by Ricciardi according to the Pope's personal interdictions.

Galileo left Rome at the end of June, delighted with the apparent agreement and overwhelmed with honors by the Pope and the Cardinals. Hardly a month had elapsed after his return to Florence when Federigo Cesi died. At the same time the plague broke out in Florence. All communication with Rome was cut off. At the frontiers of the State of the Holy See the most

scrupulous precautions were taken to prevent contamination. Even letters were submitted to such a process of disinfection that if they were ever delivered at all they were illegible. It was obviously impossible to print the book in Rome, or even submit it to the censor at the Vatican, since it involved the risk of losing the voluminous manuscript which had cost Galileo years of labor.

Galileo wrote to the Ambassador, to Catherine Ricciardi, and to other powerful friends, begging them to intercede with the Roman authorities for permission to publish the book in Florence. After an endless exchange of letters which dragged on until the end of November, Father Ricciardi gave in. He accepted Father Stefani as reviser in Florence, but insisted that at least he be shown the preface and the conclusion of the book. These he wished to edit himself, having decided that as far as the rest was concerned, he would send his instructions direct to the Inquisitor in Florence.

The Pope knew nothing of all this. He informed Galileo that the ecclesiastical pension which had been intended for his son, Vincenzo, would henceforth be paid to the scientist himself for administrative reasons. But in order to have the right to collect it he must submit to the first tonsure and say prayers to the Madonna daily. Not a single allusion did he make to the Imprimatur.

Father Ricciardi had received the preface and the conclusion of the book as requested, but he was slow about returning them. Becoming impatient, Galileo protested to Cioli, the First Secretary of State in Florence. He pointed out that he had submitted to the authority of the Church and had done everything

that its wisdom had asked of him. The perpetual fear haunted him that he might die before the publication of the work that meant everything in the world to him.

The Grand Duke was touched by his anxiety and caused a letter to be sent to Ambassador Niccolini. In it he said that he was personally interested in the publication and told him to use all his influence to bring the matter to a satisfactory conclusion.

As a matter of fact, the Ambassador had already made several moves, but he welcomed this letter as fresh means of stimulating Father Ricciardi to action by making him realize that he would be making himself personally agreeable to Ferdinand II.

Ricciardi was worried. He had an intuition that this business might mean trouble. He had received his instructions from the Pope and wanted to make sure that they would be carried out. He doubted the perspicacity of the Florentine Inquisitors, and he was only too well aware that Galileo's ideas concerning the new astronomy and its relation to the Scriptures were not any too acceptable to the ecclesiastical authorities. He was anxious enough to please the Grand Duke, but he did not want to imperil Galileo's reputation and liberty any more than his own. He admitted that Father Stefani might have read and corrected the work with his eyes open, but he added that Father Stefani was not in actual touch with the Pope's intentions. In spite of these scruples he gave in to the insistence of his sister and the Ambassador, who must have used powerful arguments.

Finally it was understood that the preface and conclusion of the book were to be returned to Galileo with important corrections, and that the Inquisitor of Flor-

ence was to receive detailed recommendations regarding the points to be observed in the body of the work.

Fresh hope, and more waiting. In May, 1631, that is to say more than a year after his visit to Rome, Galileo was still in uncertainty. A wave of revolt swept over him, not only against the tyranny of those in power, but also against the weakness of the Florentine government and its subordination to the Church.

"Realize," he wrote to the first minister, "that Father Ricciardi, after having kept me in suspense for more than a year, and having reached a conclusion, is now prepared to begin the same business all over again with his Serene Highness, the Grand Duke. It seems to me that such a thing should not be tolerated."

He suggested outright to his sovereign that the authorization of Rome should be superseded, and the counsellors of the Court, the Inquisitor of Florence and Father Stefani be called together in order to decide once and for all whether or not his book was worthy of publication.

It was a call to independence, but the Medici were too cowardly to follow the example of the Venetian Doge, and all the Grand Duke did was to write urgently to Rome.

At last the Master of the Vatican wrote the following letter to Clement Egidio, Inquisitor-General of Florence:

"You may take it upon your own authority to permit or ban the printing of the book without depending on my revision. But I must remind you that His Holiness does not wish the subject to bear on the ebb and flow of the tides, but solely

on the purely mathematical consideration of the theory of Copernicus, in order that if the revelation is contrary to the Sacred Word, appearances may still be saved, thanks to this reservation. Therefore the opinion must not be advanced as an absolute truth but only as having an hypothetical value.

"Quotations from the Scriptures must be included. In conformity with the preface and conclusion of the work which I return to you duly amended, the author must prove that all the reasons which can be invoked in favor of his theory were known to Rome and were not condemned without reason.

"If these precautions are taken the book will not encounter any obstacles in Rome, and you will be able to make yourself agreeable to the author while serving His Serene Highness who has shown so much interest in this affair."

By taking this attitude Ricciardi hoped to evade his responsibilities. He tried to talk himself into arguments which would relieve his uneasiness, but it was with ill grace that he finally allowed the preface and the conclusion of the work which he had edited to be taken out of his hands. In the meantime another month had elapsed.

When Venice heard of the obstacles which were put in the way of the publication, generous offers of all sorts reached Galileo. Francesco Duodo, a former pupil, wrote the following touching letter:

"When I met His Eminence, the Procurator Morosini, two days ago, he gave me to understand how happy Venice would be to welcome you back

under conditions which would do you honor. I promised to let you know. He added that he knew the difficulties which you were encountering on the subject of your works, and that if you would care to have them printed in Venice, he and others would subscribe thereto immediately."

How Galileo must have regretted that he had ever abandoned the hospitable soil where he had known such happiness and freedom during eighteen years. How petty Florence must have seemed to him as compared with the Venetian Republic. But it was too late to retrace his steps, for the book had already gone to Press. Galileo wrote with considerable emotion to thank Morosini for his generous offer.

The work appeared at the beginning of March, 1632 under the title of "Dialogue on the Two Greatest Systems in the World." It was dedicated to Ferdinand II, Grand Duke of Tuscany. Under the editor's personal supervision a great many copies were sent to Paris, Lyons, Bologna and Venice, but only a few reached Rome on account of the plague and the difficulties of communication.

The book was an unprecedented success. The greatest enthusiasm echoed from all parts of Europe. Father Fulgenzio Miccanzio stated that it was the most beautiful work that had ever been written on natural causation. Alexander Caccia of Pistoja read it eagerly and said that it was full of new ideas and profound observations expressed in delightful manner, beside being quite understandable to the uninitiated reader.

Benedetto Castelli studied every page with passionate astonishment. He shared his joy over it with his pupil, Evangelista Torricelli, who was already well known as a physician and geometrician of considerable

worth. Campanella said that the "Dialogue" supplied endless food for thought, and he added "this renaissance of old truths, these new worlds, these new stars, these new systems and these new ideas, announce the beginning of a new epoch."

Everybody who admired the work did not agree, however, on the question of the tides as a proof of terrestrial revolution. Galileo's friends, Caccia and Campanella, were both doubtful, but that did not prevent the majority declaring that the "Dialogue" was the most important book that had ever been printed.

Trouble was sown in the adversaries' camp. Father Schreiner, the man who had claimed the first discovery of the sun spots, and who had never been able to forgive Galileo for having contested this claim, happened to be at a library in Rome. When he heard the statement that the "Dialogue" was the most impressive work of the age, he became livid and trembled violently, to the great astonishment of the librarian and other witnesses. When he recovered from his agitation he expressed a desire to buy the book at no matter what cost, in order to write an answer to it immediately. But there were only a few copies in Rome. They had been sent to friends with the inscription "book unmounted and without string", in order to avoid interception by the sanitary service. This meant that they had not been handled, that is to say bound, etc., after the actual printing. It was impossible to present them in this condition either to the libraries or to the members of the Court.

That is why weeks went by before the Roman authorities, especially the Pope, realized the outrage which had taken place under their very eyes.

Chapter XXXI

THE INQUIRY

WHEN the Pope finally held the "Dialogue" in his hands and realized that his ministers Ricciardi and Gianpoli had given it the Imprimatur without regard to his precise instructions; when he found out that far from treating the Copernican question as a mathematical hypothesis, Galileo had confirmed it with physical arguments, thus rendering null and void the order given by the Master of the Grand Palace, according to which the author was ordered to justify the decisions of the Church; when he saw that the book lowered the prestige of authority by making a dead letter of his directions and thus favoring free interpretation—he is said to have burst into a violent rage.

From that moment he persecuted Galileo implacably, subordinating his personal friendships to the interest of the State and the integrity of ecclesiastical power. He decided to take extreme measures. A special commission charged with the inquiry summed up all the facts and asserted that the following accusations were to be made against the author.

Firstly, of having set the mark of the Imprimatur on the work without the final order sanctioning the temporary signature. Secondly, of having printed the preface in distinctive type, thus rendering it foreign to the body of the work, and of having put the final argument into the mouth of a fool. Thirdly, of hav-

ing discarded hypothesis, both by affirming the mobility of the earth and the stability of the sun and by qualifying the arguments on which the proofs are based as demonstrative and final. Fourthly, of having treated the question as if it had not been opposed by the Church. Fifthly, of having abused authors who disagreed (with the Copernican opinions), more especially those on whom the Holy Church chiefly relies. Sixthly, of having confused human intelligence with divine intelligence to a great extent in the understanding of geometry. Seventhly, of having stated as a fact and having used as an argument that the partisans of Ptolemy, that is to say the ancient astronomy, set aside Copernicus. Eighthly, of having identified the immobility of the sun and the mobility of the earth, which does not exist, with the ebb and flow of the sea, which does exist.

The commission declared that all these errors could be corrected if the work itself were really worth printing, but they pointed out that the author had received the intimation in 1616 that he abandon the opinions in question entirely and that he neither teach them nor defend them, either orally or by writing under threat of proceedings by the Holy See.

The eighth paragraph was the keynote to the ensuing drama.

The Pope had insistently argued this point at the time when he was still a cardinal and on friendly terms with Galileo. He had emphasized that Galileo was only right so long as his contention was limited to the realm of science. This divergence of opinions is commonly supposed to be the essential cause of Galileo's downfall. He has always been accused of having aroused implacable hatred by opposing himself to the

Pope's opinions and giving his side of the argument to the most unintelligent character in the "Dialogue".

This character, Simplicio, is the only one who upholds the conventional ideas disapproved by Galileo. Even friends like Kepler, Miccancio, Campanella did not accept the tides as proof of the earth's movement. Like the Pope, they attributed them to lunar attraction.

But this difference of opinion did not prevent Galileo from appreciating his friends. There was great mutual admiration between him and Urban VIII, who was not a man capable of avenging himself basely and abusing his powers because one of his scientific preferences had not been upheld. He was above such pettiness. He charged the commission to investigate for considerations of an entirely different nature. He was uniquely worried about the religious consequences if the book were published. Experience had taught him in the past that development of the system of Copernicus presupposed a heavenly universe, innumerable worlds and a God intimately connected with them. The dogmas and mysteries of religion were thus rejected as meaningless. They became mere symbols of morality. Free interpretation was the vital source of the danger menacing the Catholic edifice. At a moment when Protestantism was engulfing Europe, might the head of the Church tolerate a blow capable of demolishing the authority of all dogma, even from his best friend?

Even supposing Urban VIII to be entirely in favor of the theories of Copernicus, he could not permit the slightest attack, however indirect, against the prestige of the Holy See. In allowing Galileo to expound the question as a mathematical hypothesis, neutralized by

a profession of Catholic faith, he was making the greatest concession possible.

The guise of mathematics and hypothesis was his only guarantee that the contents of the "Dialogue" would remain speculative, and therefore unconvincing. His disappointment and his disquiet were great when he realized that his hope had been an illusion. Galileo had made his opinions perfectly clear. Invoking the tides as an illustration was conclusive. Here was an immediate proof, according to Galileo at least, of the rotation of the earth available to the meanest intelligence.

This, then, was the dominant evil, and, combined with the fact that he had seen fit to avail himself of Father Ricciardi's provisional Imprimatur, it gave what might be regarded as official sanction to his offence. Then, too, the preface meant nothing because the contents of the book frankly contradicted it, and the fact that it was printed in distinctive print seemed a flagrant manner of pointing out that the preamble was an administrative formality and had nothing to do with the leading arguments of the author. The ultimate reproach was that he had acted against the orders of the Holy See as given in 1616 and had thus fallen into the sin of recidivism, which meant that the guilty man was liable to the most terrible sanctions by the Inquisition.

From the moment that the full extent of Galileo's crime was grasped an order was issued to the Inquisitor in Florence. All circulation of the book in Italy and in foreign countries was to be stopped until further notice. This ban took effect in July, 1632 while the "Dialogue" was stirring public opinion.

Galileo, although ill, was drunk with success. He

really believed that he had attained the height of his ambition. He was still unaware of the fact that the Pope had intervened. Filippo Magerlotti, a friend of Galileo, who had taken several copies of the "Dialogue" to Rome for local distribution, received a visit from Ricciardi on August seventh, 1632. He asked Magerlotti to let him have the copies for a few days, in order to compare certain passages with works that he had in his own possession. Magerlotti, scenting danger, excused himself, but took advantage of the visit to ask what was happening and why the book was being banned.

Of course Father Ricciardi, bound by the oath of silence, could not tell him anything; but he gave himself away when he asked a question which would have been funny if the situation had not been so tragic.

He wanted very much to know the exact meaning of the drawing in the frontispiece representing three dolphins biting their own tails. This symbol had apparently created quite a disturbance. It was being considered as some sort of secret sign of alliance between the Galileists. Magerlotti had difficulty in convincing the father that these fish were simply Landini's device. Galileo had no need to avail himself of mysterious signs, he said, since he had exposed his thoughts so clearly.

In spite of his oath of professional secrecy, Ricciardi did say: "The Jesuits will prosecute him with the utmost harshness". Yet no preponderating influence of the Jesuits was apparent in the suit. If they took any action it must have been in secret. They were doubtless consulted regarding the value of the incriminating work, and they must have gone to extremes in order to exaggerate its menace, for it is absolutely certain that,

since the encounter with Father Grassi, the Jesuits, who had formerly been so favorable to Galileo, had become his enemies. They were not the kind to forgive those who not only would not flatter them, but told painful truths. Nevertheless, no certain proofs ever revealed any active animosity on their part in this particular affair. If the proceedings were envenomed by their ill will, they must have acted with their customary underhand skill and the diplomacy for which they were famous.

Ricciardi wrote to the Inquisitor in Florence telling him to find out how many copies of the "Dialogue" had been delivered throughout Europe, and even their exact destination if possible, in order that they might be confiscated. There was a distinct impression that the Pope, in trying to withdraw the "Dialogue" from circulation, was doing everything in his power to stop the scandal and so save Galileo from the Inquisition, and at the same time prevent his ideas from spreading.

But he did not succeed. Echoes of comments about the "Dialogue" reached the Pope from all sides and he realized that it was too late to stop the cataclysm.

Galileo was just beginning to realize his danger, and his friends began to worry, too, though they did not suspect how far things had actually gone.

Fra Fulgenzio Miccanzio wrote that, after having read the book, he anticipated the utmost hostility from those who considered that they had the right to shape events. He feared above all that they might prevent Galileo from publishing his work on the laws of motion and the resistance of bodies. The fate of those works seemed to perturb him more than that of their author.

It was the philosopher Campanella who gave the alarm. He warned Galileo that there were neither mathematicians nor able physicists among the commissioners examining his cause. Naïvely he incited the scientist to demand that both he and Castelli, who was also under suspicion, be admitted into the congregation, since he was to be condemned for heresy. Forgetting that he himself had passed half his life in the dungeons of the Holy See, he advised Galileo to invoke in his defence the recognized principle that the decree of the Church may be admitted without its reasoning being necessarily accepted. This advice, though given with the best intentions, was terribly mistaken. Fortunately there was somebody on the alert who had the same boundless devotion, but greater wisdom.

This was Ambassador Niccolini. As soon as he heard that a commission had been formed under the presidency of Francesco Barberini, and composed of men unfavorable to Galileo, he decided to ask for an audience in order to obtain a promise of impartiality. He begged the Grand Duke to try and influence Ciaramonte, an astronomer curiously hostile to all innovations, who was to be sent for from Pisa as consultant. He also warned him not to designate men like Campanella and Castelli as advocates, since they could only harm Galileo's cause.

But the minister Cioli, probably at Galileo's own request, advised the ambassador himself of His Highness' amazement that a book which had been authorized two years earlier in Rome and published in the interests of religion, should be the object of such unfavorable attention. "In any case," he said, "the accused must be granted the privilege of defending

himself, and the objections should be written down so that Galileo may answer to the best of his ability."

Galileo's reason is clear. Obsessed by the unscrupulousness of his invisible enemies, he wanted an opportunity to reply to definite accusations, not to distorted rumors. He could not bring himself to believe that the Pope, who had never been in favor of the decree of 1616, would allow him to be dragged before a tribunal.

But he was soon forced to realize that this was not impossible. On September fourth, 1632 Niccolini had a long interview with Urban VIII. While he was generalizing about the dissensions with which the Holy See had to contend, the Pope suddenly became violently angry. He pointed out that Galileo had dared enter into questions which were the most serious and the most perilous that could be raised at that epoch.

This spontaneous outburst clearly showed the Pope's attitude in the matter. He repeated for the hundredth time that Galileo's book was a direct incentive to free thinking and religious disobedience and that it had appeared at a moment when Protestantism and heresies were making ravages and placing the Holy See in the most formidable difficulties. The Pope complained bitterly that Monsignor Gianpoli, hand in glove with Galileo, had deceived him by telling him that there was nothing incorrect in the text of the "Dialogue", thereby circumventing Ricciardi, his Grand Master.

Niccolini tried to pacify him. According to the instructions he had received from Florence he asked him to give Galileo the chance to clear himself. Employing the form of the "Dialogue", they said in substance:

The Pope: In these matters the Holy See allows itself to censure, and then invites the accused to clear himself if he can.

Niccolini: Does it not seem only fair to Your Holiness that Galileo be told the difficulties in advance and thus know the opposition which has been made to his work and what is displeasing in this latter to the Holy See?

The Pope: (*violently*) The Holy See, we repeat to Your Eminence, does not proceed in that manner. Never has any one been given the evidence against him in advance of his examination. It is not customary. Galileo knows perfectly well wherein the difficulty lies, since we have discussed it together and he has heard it from my own lips.

Niccolini: I beg you to consider the fact that the book is dedicated to His Serene Highness, and that the author is actually in the Duke's service.

The Pope: We have even prohibited books which were dedicated to us. His Highness being a Christian prince should be the first to punish any responsible person who risks prejudicing religion. In this case the prejudices are the worst which have ever been conceived. It would be better for His Highness not to engage himself in this battle from which he would be unable to withdraw with honor.

Niccolini: In any case I do not think that, after having authorized the book, Your Beatitude can tolerate that it be banned without even having heard Galileo on the subject.

The Pope: That is the least ill that could come to

Galileo. Please God he will not be convoked by the Holy See. A commission of theologians and wise men, who are both serious and honest, has been summoned to examine his cause and weigh the contents of the "Dialogue" word for word. We have shown great urbanity towards Galileo in this most pernicious affair; for he knew our wishes. Instead of submitting his case to the Congregation of the Holy Inquisition, as we ought have done, we have confided it to a commission created for that purpose with especial privileges, thus showing him more consideration than he showed us when he deceived us.

He reassured Niccolini regarding members of the Commission of Inquiry, and confided to him under the seal of secrecy that he himself had proposed the present judge advocate. This was the Father Inchofer, a Jesuit and a man of perfect loyalty. But he added that the real danger lay in the damning fact that Galileo had not respected the admonition of 1616, and this recidivism might be sufficient to ruin him.

Chapter XXXII

THE JOURNEY BY LITTER

THE special commission, after a thorough investigation, decided that the case must revert to the Holy See in view of its gravity and also because it involved an earlier delinquency. The head of the Church could not decently oppose himself to the customary procedure.

He forewarned Ambassador Niccolini, but in exchange for this unusual concession he demanded of him and his sovereign the oath of silence under threat of excommunication.

Niccolini received the news sorrowfully. Experience had taught him that the Inquisition was not to be held lightly. He appealed once more to the Pope, who, though apparently almighty, was really powerless to stop the persecution once it had gained headway.

On whom, then, did Galileo's fate hang? Actually on nobody in particular. Not even the members of the Holy See. They judged according to the canonical laws and the Inquisitorial manuals, and even with the utmost good will it was difficult for them to find any extenuating circumstance in the behavior of the accused. The Court which was to judge this case was erroneously said to include the inventor's bitterest enemies. As a matter of historic fact the General Commissioner, Father Firenzuolo, who has always been depicted as the most hostile, proved to be the one who

made the most efficacious efforts to save Galileo. Another member of this tribunal was Cardinal Bentivoglio who had been Galileo's disciple at Padua.

In his *Memoirs*, which were published in Venice in 1648, he wrote: "God knows how painful it is to me to see an Archimedes so unfortunately situated through his own fault; for he had published his opinions regarding the movements of the earth contrary to the real meaning unanimously agreed by the Church; opinions which forced him to present himself before the Holy See in Rome where I was then holding the position of Chief Inquisitor, and where I tried my utmost to come to his aid."

These words, written by a pupil and an admirer, were hardly those of an enemy, but rather emanated from a believer and a theologian whose mission it was to save the integrity of the Faith. If any single dogma of the Church were contaminated, then all dogmas must lose their value. They were no longer dealing with a given individual or his opinions. It was a turning point in history and became the defense undertaken by an organization based on faith against the dissolving forces of independent thought.

The drama was enacted on the high plane of general interest, and its development gives no proof of any individual animosity or the human jealousy of any particular man. It was absolutely impersonal.

While the Church was preparing to silence the man who had enlightened an epoch, Torricelli, Castelli's famous pupil, openly proclaimed himself Galileo's disciple, and wrote that he counted himself happy to have lived in an epoch in which it was granted to him to know and to revere Galileo who was the oracle of Nature. He begged him to deign to count him, un-

worthy though he was, among the number of the seekers of truth.

During its sitting the tribunal registered the following decision:

"The Pope has ordered that the Inquisitor in Florence be written to in the name of the Holy Congregation in order to signify to Galileo that he must appear in Rome during the month of October before the General Commission of the Holy See.

"Also he must obtain from Galileo a promise to obey this order in the presence of a notary and witnesses whose rôle he was to ignore, so that they might testify in case the accused refused to bow before the order or to promise obedience."

This document gives a good example of the traps set by the Inquisition for its victims.

Benedetto Castelli went to Father Firenzuolo, who was a personal friend, and warned him to beware of a verdict which was unjustifiable and which therefore might diminish the prestige of the Tribunal. Taking advantage of his friendship, he dared address him in these terms:

"Reverend Father Commissioner, I find it expressly stated in St. Augustine that official interpreters discussed the question of whether the earth moved or not, and that they came to no conclusion and taught nothing on this subject because it was not important to the saving of souls. Then, many centuries after St. Augustine, Copernicus was born. He was a man of great genius who, after infinite research and herculean

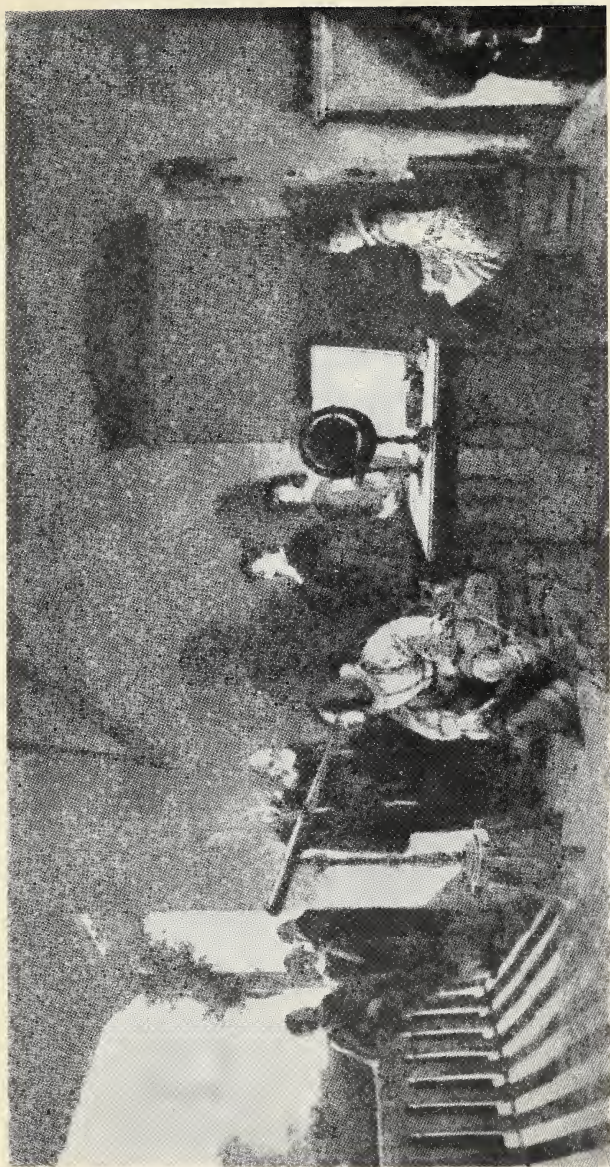
labors, wrote his work on the "Revolution of the Celestial Orbs and On the Constitution of the World". Encouraged by the great Cardinals, Nicolo Scombergio, and other pious and learned bishops, he published his book and dedicated it to that very wise Sovereign Pontiff, Paul III. On this basis and with the help of indexes left by the author, our Sainted Mother, the Church, completed the amendments for the year in such a manner that the work of Copernicus was tacitly approved by the ecclesiastical authorities.¹

"By bearing these facts in mind, and persuaded by experience and observation, I spontaneously state that I have no scruples in believing that the earth moves in the manner attributed to it by Copernicus."

Although Firenzuolo was his friend, Castelli gave proof of great courage, because friendship has little place in the byways of the Inquisition. The astounding fact was that the Father Commissioner answered that he was of the same opinion, and that as he considered that none should attempt to solve such a question by quoting from the Bible, he proposed to make a report on the subject. This unexpected reply did not reveal a Firenzuolo inimicable to Galileo or his doctrines. There is no reason to suspect his good faith, because ultimate events show him to have been on Galileo's side.

Only Firenzuolo had no unique authority to make decisions. He depended, like his colleagues, on the reports of the counsellors and the rules of the Holy

¹ It was the question of the modification of the calendar decreed in 1582 by Pope Gregory XVIII. Hence the name "Gregorian calendar."



IN AUGUST, 1638, THE POET MILTON "FOUND AND VISITED" THE MASTER OF THE STARS,
NOW OLD AND BLIND.

Office. "Time alone," said Castelli to Galileo, "will be the equitable judge of your honorable and dignified work; but this time is not yet near."

Galileo asked the Grand Duke whether he considered that he should obey the order to go to Rome. The answer was apparently affirmative, since on October eighteenth he wrote to the Cardinal Francesco Barberini explaining that worries, in addition to his age and his ill health, would prevent his departure during the period of the epidemic, unless he was to risk his life. He therefore begged the authorization to send his defence to Rome in writing, or to be questioned in Florence where, as he pointed out, neither Inquisitors nor ministers of the cult were lacking. While his friends in Florence were stating through Father Miccanzio that they preferred excommunication to being deprived of Galileo's book, the cowardly Florentine monarch was doing nothing to protect his mathematician.

Galileo's request was not granted. On the back of the letter the Pope wrote with his own hand: "This affair has been settled at the last meeting of the Holy Office. There is no other answer to be given."

Niccolini insisted, representing to the Pope the danger of the plague, the difficulties of communication, the necessity of a long and painful quarantine and the age and health of the scientist. He was careful not to harp on Galileo's proposition that he be allowed to justify himself by writing, or be tried in Florence. He knew that the Inquisitor would tolerate no vestige of resistance and that any such alternative would exasperate him still further and result in a sweeping and pitiless condemnation.

He also knew that it was useless for Galileo to try

and evade the process and escape imprisonment, but he tried desperately to obtain a delay which would enable his protégé to gain enough strength for the fatigues of the journey.

"I would gladly," he wrote, "give my own blood for you, but it is a question of the Holy See. Because of the menace of excommunication, nobody will answer when asked for information. I have told the Pope," he added, "everything that my affection for you could suggest to me."

It was all hopeless. The preliminary inquiry proceeded in silence. On November eleventh the Tribunal decreed: "The Most Holy Father will concede nothing, and has given orders to the Inquisitor in Florence to constrain the accused to obey and come to Rome."

It is notable that in every case the Holy See gave its decisions in the name of the Pope, even if the latter were not present. It was an administrative formula which did not necessarily imply direct responsibility on the part of the Sovereign Pontiff.

Niccolini preferred to address himself direct to the Pope, because, as he said, the members of the Inquisition "listen but do not answer." But the resolution was immutable, and the only concession Niccolini could obtain was the reduction of the period of quarantine.

But the month of October, the date set for Galileo to appear in Rome, was over. November also went by. On his own initiative the Inquisitor of Florence, who was very humane, accorded another month's delay to the wretched old man, seeing that it was impossible for the latter to travel.

The Roman authorities were furious. At the ultimate date the sick man was worse than ever. The First Secretary of State, Andrea Cioli, might well write to

Rome that "poor Galileo is in bed, and he runs the risk of going to another world rather than to Rome. God has said, 'I do not desire the death of a sinner'."

Although Clement Egidio, the Inquisitor of Florence, pointed out Galileo's good will and presented certificates from three great doctors certifying that the sick man was in no condition to bear the fatigues of travelling, nothing succeeded in softening his judges. They became more and more impatient.

This is the order which was sent in December, 1632, by the Congregation, all of them men who had known, loved and admired Galileo:

"If he is in any condition to come, let him be seized, bound and transported. If his life is really in danger, let this voyage be postponed. But the moment he is convalescent and all danger is passed, let him be put in chains and brought to Rome."

This remote concession was made because it was irregular to do anything that might cause the death of an accused man before trial. Castelli, unable to mitigate this horrible ordeal, knew how delay and apparent disobedience to the injunctions of the Holy See would harm his master.

He therefore wrote him the following words, which convey his revolt and his distress, but also his resignation in view of an implacable necessity:

"Your persecutors desire nothing more than your actual absence from Rome in order to be able to agitate against you publicly and call you a rebel guilty of contumacy, although the excuses which you present are legitimate. That is why I

hope that you will be energetic and make a great effort to overcome your weakness and set out in spite of the bad weather. Commend yourself to God and come quickly, because I have every hope that you will overcome all difficulties."

This encouragement was kindly, but Castelli must have known that his master could not possibly escape punishment, although he might mitigate its harshness by prompt action. He was right.

Galileo made a supreme effort to leave. He had heard that the Jesuit Fathers had succeeded in convincing the judges that the "Dialogue" was more execrable and pernicious than the writings of either Luther or Calvin. He realized that it was urgently necessary not to leave them under this false impression which might mean his infamous death on the public scaffold.

He left for Rome on a litter. It was bitterly cold and the weather was vile. During his long voyage and the eighteen days of quarantine he thought bitterly of what was in store for him. His undiminished faith gave him the courage to live and to go on fighting at a moment when Fate seemed to have abandoned him.

If only a message could have reached him giving a ray of hope that he might not have to end his days in prison, what a consolation it would have been to him on his endless journey, and to the loyal friends who said goodbye to him in Florence with the agonising fear that they were seeing him for the last time.

Chapter XXXIII

THE GODS ARE THIRSTY

GALILEO arrived in the Eternal City on January twenty-third, 1633. He was received with filial tenderness by Niccolini, who surrounded him with every care in his own home while waiting for the Holy See to decide his fate. Next day he put himself at the disposal of the religious authorities accompanied by Monsignor Boccabella, a former assessor of the Tribunal, who was a friend of the Ambassador's and an invaluable advisor to Galileo in these perilous circumstances.

At Niccolini's urgent request Galileo was provisionally spared a dungeon, but he was expressly ordered to receive no visitors and to live the life of a prisoner. Firenzuolo, the General Commissioner of the Holy See, promised to dwell on the promptness with which the accused had obeyed the injunctions of his superiors, hoping that this might further his cause.

One day Galileo received a visit from a member of the Congregation who came to question him and gave him the opportunity of expressing his devotion to the Church. His questioner seemed to approve Galileo's answers. This treatment had nothing in common with the chains and prison which he had dreaded. He knew nothing of the inexhaustible tricks used by the Inquisition. Their choicest method was winning the confidence of the accused and surprising him into an indirect

confession of heresy. But it was careful to stay within the bounds when it used certain procedures which were not particularly honorable, but were nearly always successful. It was the most appalling institution humanity had ever conceived, for it did not hesitate to employ the vilest means of accomplishing its nominal purpose of saving souls.

To a certain extent Galileo was privileged. He was too famous and too well protected by sovereigns and men of state for the Church, cleverest of politicians, not to conciliate susceptibilities compatible with its own conservation.

Ever optimistic, Galileo saw himself free. All the accusations against him had been reduced to the one which he would be the most easily able to justify: that of having disobeyed the decree of 1616. But while he was confident that he was convincing his judges, the latter were secretly noting what they chose to call his obstinacy.

Sister Maria Celeste rejoiced in the turn of events and prayed incessantly that her father might escape censure. Urgent recommendations came from Florence to the Cardinal-Inquisitors Bentivoglio and Scaglia. Niccolini fought desperately to save the scientist who was alternating between fear and hope.

A month later the Ambassador heard that the grave imputations weighing upon the accused had been confirmed by the Pope. "May God forgive him," said the Sovereign Pontiff, "for having involved himself in these questions;" and he underlined the fact that the fundamental error was having upheld the modern doctrines concerning the Scriptures and thus having committed the error of creating a new philosophy. What

today would be a claim to honor was at that time considered an abomination.

"There is one argument," declared the Pope, "which nobody has ever been able to refute, which is that God is almighty and may do as He sees fit. If He can do all, why question His works?"

This was the basis of the mental attitude which separated the past from the present. To the chosen few, submitting Nature to laws as Galileo had done was the freeing of the spirit. It became possible to disentangle a multitude of facts and explain them without the help of blind intuition. But in the eyes of the Church it questioned God's free will. According to them He had the right to interfere in all things and even alter natural phenomena as He saw fit. The miracles and the supernatural, set at nought by Galileo's science, were the columns of the temple. Remove them and the entire edifice must crumble.

Urban VIII told Niccolini that the accused would certainly be summoned before the Holy Office, and that during the period of actual examination he would have to remain in any prison they chose to designate. He promised to give him the best accommodation possible, both out of personal consideration and out of deference to the Grand Duke who had always been so devoted a friend to the Church.

Niccolini was appalled. He dared not tell Galileo what was in store for him, fearing that it might deal a fatal blow to an old man exhausted by illness and anxiety.

But this consideration was unnecessary. Galileo, after half a century of battle, was assisting at the birth of a revolution which he himself had been generating ever since the beginning of his career. Having fathered

it, he was big enough to accept his share, no matter what his own fate might be if only the salvation of future generations might be born of his sufferings.

But that he, whose thought had enlightened the world and who had always been a true Catholic in spite of what theologians might say, should be locked into a prison seemed beyond endurance. The Ambassador implored him to submit humbly to this order and, no matter what it involved, urged him not to attempt to defend his opinions, but to bow humbly before his accusers and show nothing but repentance. It was his only chance of saving himself from death. He owed this not only to his friends but to himself, because his work was not yet completed and he had no right to deprive the world of its inheritance.

So Galileo went bravely to his prison carrying on his shoulders the heavy responsibility of the world's emancipation. He was apparently received in the chancellery of the Holy See with the utmost consideration. But it must not be forgotten that a prisoner was always threatened with the direst penalties should he ever reveal anything that happened to him. That is why the truth will never really be known; but it may be concluded that he was not treated with the customary harshness, since the Ambassador's servants were allowed to bring him special food and a valet took care of him and slept in the next room.

The first inquiry took place on April twelfth, 1633. Galileo admitted that his opinions regarding the movement of the earth and the stability of the sun had been formerly condemned by the Congregation of the Index as being absolutely contrary to the Holy Scriptures, and that in 1616 he had received an injunction from

Bellarmin restraining him from upholding this theory or defending it except as a mere supposition. The tribunal reminded him that in the precept there had been a clause forbidding him to continue believing or teaching the aforesaid opinion in any manner. Galileo answered that the personal certificate sent him by Bellarmin did not contain the phrase "teaching in any manner", and that he could not remember details of the paper which he had signed so many years earlier. If he had not mentioned this precept to the Master of the Vatican when asking for the Imprimatur it was because he did not consider that he was upholding the theory of the mobility of the earth. On the contrary, he was proving that Copernicus' reasoning was not acceptable.

This was Galileo's first deposition. He made it after his oath of silence. He fondly imagined that his declarations would be accepted literally as they were received with apparent good will and approval. As a matter of fact, they did not believe a word he said. On the contrary, it was for having defended the Copernican theory that he had been called before the tribunal. By taking a negative attitude he antagonized the Holy See more than ever. They only wanted one thing from him: a confession of heresy and sincere repentance.

Niccolini waited in agony to hear Galileo's fate. On April sixteenth he wrote to the Grand Duke's first minister: "Galileo suffers at the Holy Office and life is hard for him. As far as I am concerned I shall continue to help him as I have always done; but at this tribunal one talks to men who answer neither by word nor by writing. That is why it is so difficult to

negotiate with them and gather their intentions. Certain of the Cardinals to whom I have given His Highness' letters have excused themselves for not answering on account of their enforced confinement during the trial, and others have even hesitated to accept them at all. Galileo must have been threatened with excommunication if he should speak of or reveal details of the inquiry, because he will not tell my servant Ptolemy anything."

The mystery remained complete. But if Galileo could not speak, the expression of his eyes spoke for him. He was tortured by the fight in his conscience between his scientific and his Catholic convictions. By publishing his "Dialogue" he had not only wished to serve science, but also to enlighten the Church and put it on its guard against false assertions which could be held against it by posterity.

But in his heart he also knew that he had certainly tried to defend the system of Copernicus and that this had not escaped the vigilance of the Inquisitors. In dissimulating before his judges he used the same ambiguous procedure which he used in his book. Still he remained convinced that his fundamental purpose had been to devote himself to the Church in spite of itself, and in spite of that very Church, remain a good Catholic.

If he had ever confessed to his secret belief in the opinion of Copernicus and his defence of it in the interests of religion and truth, he would have complicated his case considerably because he would have been adding the abominable heresy of wishing to reform the Church to his crime of disobedience, and he would certainly have been condemned without pity as

an impenitent heretic and have been sent straight to the stake after having been subjected to excommunication and anathema, things intolerable to his soul as a believer. His only chance was to deny his adherence to Copernicus; but the Inquisition, which had brought him to Rome in order to make him recognize his fault and abjure, would not accept this attitude. The result of the first inquiry was detrimental to Galileo and they decided to proceed with "greater vigor".

It was Firenzuolo who obtained the authorization to talk to Galileo informally. He wanted to make him realize the essential fact of his sin and induce him to confess to it. After a long interview he succeeded in making him admit that he had unquestionably furnished proofs of the movement of the earth. Galileo did not wish to appear to contradict himself or be lacking in his religious duty, so he sought means by which he could state simultaneously that he had had no intention of giving weight to the undesirable theory, and yet that he had actually upheld it. This was his line of defence in the second official inquiry on April second, 1633.

"I freely confess," he said to his judges, "that on rereading my 'Dialogue' it seems to me to have been so edited that, to the reader unaware of my true intentions, the arguments for the Copernicean system which I meant to refute, are represented in such a way that they may have been *for* rather than *against* it. In order to excuse myself in my own eyes for having fallen into an error so far from my real intention, and for not having been content to say only that which was needful in order to refute the arguments of my contradictors, and above all for having in a dialogue

represented them in a conclusive manner instead of belittling them . . . I explain my excess by the natural complaisance that we all feel for our own subtleties, even when it is a question of finding an ingenious argument of apparent probability for false propositions. My error has simply been, and I confess it, one of vain ambition and pure ignorance."

In other words he implied that he had indulged in sophistries which had caused misinterpretation. It had not been his intention to take a definite stand regarding the movement of the earth, and he tried to make the tribunal believe this by admitting his error without repudiating his previous declarations or appearing a bad Catholic.

After the inquiry Galileo was allowed to return to the Ambassador's house, thanks to the intervention of Firenzuolo and Cardinal Barberini.

Maria Celeste, on learning that her father had been set at liberty, thanked God humbly for hearing her prayers. But her rejoicing was premature. Galileo's semi-confession had by no means satisfied his insatiable judges who wanted confession without restrictions, exhaustive and absolute, according to the rules. They gave him provisional liberty in order that he might have time to think and pray and see the road to salvation. But not one of them had the right to tell him what to do in order to save himself. The confession had to be spontaneous and sincere.

Called to the palace of the Holy See on May tenth, 1633, he was notified that he would be granted eight days in which to prepare his defence. The word "defence" was a trap. Galileo fell into it. Without giving himself time to think, he immediately read them a

statement in which he confirmed everything that he had already said, and which concluded with a plea for indulgence and pity.

Galileo was once more the Ambassador's guest, but not for long. After the congregation of June sixteenth, things suddenly took a tragic turn. It was decided to turn the "Dialogue" over to the Index and to question Galileo regarding his absolute meaning, under threat of torture.

On the second of June the accused was called before the Holy See. The following is an extract of the proceedings:

"Questioned as to whether he believed, or ever had believed, and for how long a period approximately, that the sun was the centre of the world and that the earth moves, he answered: 'For some time since. That is to say before the determination of the Sacred Congregation of the Index, I considered the two opinions, that of Ptolemy and that of Copernicus, were subject to discussion, because either of them might be correct according to Nature. But later . . . convinced by the wisdom of my superiors, my doubts ceased, and I have since held as I still do, that the opinion of Ptolemy is correct and cannot be doubted . . . that is to say, the stability of the earth, and the mobility of the sun.'

"Objection was raised that according to the contents of the 'Dialogue' he had continued to adopt the incriminating opinion, and he was once more invited to tell the truth.

"He answered: 'Regarding what concerns the published "Dialogue," I did not write it because I

believed in the truth of the Copernicean theories, but only because I estimated in the common interest that I should explain the natural and the astronomical reasons on both sides.'

"He was warned that if he did not decide to tell the truth, drastic action would be taken against him.

"He answered: 'I do not hold, and have never held, the opinions of Copernicus since the order was given me to abandon them. In any case, I am here in your hands. Do as you think best.'

"Thereby he was once more ordered to tell the truth, in default of which he would be tortured. He answered: 'I am here to obey. As I have said, I did not uphold this opinion after the decision was reached.'"

Galileo was then put in prison. He had signed his own condemnation in spite of the cowardly disavowal to which he had been driven.

The proceedings followed their natural course. In the shadow of the prison walls the old man must have been submitted to further questioning in the presence of the delegates of the tribunal who were piously assembled about him to receive his total confession. Instruments of torture tore from his mouth the Catholic confession that was demanded of sinners.

His sentence read:

"It seeming to us that you have not told the entire truth regarding your intention, we have judged it necessary to proceed against you by means of rigorous examination, under which . . . you answered Catholically."

Why curse the Inquisitor who, closing his soul to charity and pity for human suffering, did not hesitate to use the most revolting cruelty? He may have been an honest man, kindly and decent in private life, but his duty to the rules of the Church then in existence forced him to use the methods considered salutary to the Faith.

Chapter XXXIV

THE ABJURATION

WHETHER Galileo suffered physical torture or not has always been a moot point, because no document exists which proves it beyond doubt. The archives of the Holy See never gave details of their persecutions, for the simple reason that no minutes were kept. They were satisfied to allude to the facts in words that could only convey a meaning to the initiated. When an interrogation did not result in the desired confession of guilt, the Holy Office spoke of submitting the delinquent to "rigorous examination". That implied torture with the object of forcing him to the desired avowal. That was the sublime test, according to the recognized procedure against heresy, and was commanded by the laws of the Inquisition when a suspect resisted persuasion.

Until the last moment Galileo denied his actual adherence to the doctrines which had been condemned by the Church. But for the salvation of his soul they demanded full confession of his real intentions. Kind words and threats had failed. The proceedings must therefore have followed their usual course. In the sentence it was stated that the accused, when submitted to rigorous examination, "answered Catholically". It is the nearest proof of torture which exists.

The wretched scientist would have suffered excommunication with all its terrible consequences if he had

dared reveal the inviolable secrets of the torture chamber. Viviani, his most privileged disciple who was with him at his death, must have had a glimpse of the truth, but he never divulged it either. Only J. Binelli, the executor of Viviani's will, had the courage to write what little he knew in a book published at Lausanne in 1793. But the procedure itself, Galileo's denial, and finally the statement of the sentence, confirm the horrible truth more emphatically than any heresy could do.

The day after the enforced confession, which made of the heretic a repentant sinner who, thanks to his confession, had escaped capital punishment, Galileo was taken to the Monastery of the Minerva to listen to his condemnation on his knees.

Although Galileo had incurred the utmost penalties of the canonical laws he was absolved on the condition that he abjure his doctrine and abhor his sin. Still, as such a fault could not be left entirely unpunished, and in order to set a good example, the judges imposed on Galileo the recitation once a week for three years of the seven penitential psalms, and condemned him to prison without naming a definite period, reserving the right to modify or mitigate the punishment according to their good will. They also ordered that the "Dialogue" be prohibited.

After having pronounced the sentence, the judges presented Galileo with the form of abjuration which he was to read on his knees:

"Before the Holy Sainted Gospels which I touch with my hands, I swear that I have always believed, that I do believe, and that with the help of God I shall continue to believe, everything be-

lieved, preached and taught by the Holy Catholic and Apostolic Church. . . .

"I have been judged vehemently suspect of heresy. That is to say, I have believed and thought that the sun was the centre of the world and immovable, and that the earth was not the centre and that it moved. . . .

"This is why, wishing to efface this grave suspicion from the minds of Your Eminences and that of all faithful Christians . . . I am come with a sincere heart and an unfeigned faith to abjure, curse and detest the errors and heresies referred to, and in general all other errors, heresies, or sects contrary to the Holy Church.

"I swear that in future I will never more utter either by word or by writing anything which might subject me again to such suspicion, and if I know a heretic, or even any one who might be suspected of heresy, I will denounce him to the Holy See or the Inquisition or to the Ordinance of the locality wherein I find myself."

Galileo signed this abjuration with his own hand. It had been said that on rising he stamped on the floor with a movement of revolt and cried "*eppur si muove!*" This is obviously only a legend, because if he had dared utter such words, he would never have been seen again. He must certainly have thought it, but it is equally certain that he never said it.

The sentence was a horrible blow to Galileo. He not only saw his career as a scientist undermined and his remaining years rendered useless, but his conscience as a believer was involved. How could he keep his faith in a Church capable of such error and in-

iquity? It is probably the reaction against this bitter disappointment that made him cry to all within hearing: "I shall remain a Christian in spite of everything!"

Immediately after the condemnation, and even before it was made official, Ambassador Niccolini obtained the concession that the penalty be commuted to banishment, first to the Villa Medici in Rome, and then to Siena at the home of the Archbishop Piccolomini. This was granted because of the Grand Duke's intervention. The dwellings indicated were to serve him as places of utter seclusion. He was not to leave them without authorization, and not to see his friends or even correspond with them.

When Sister Maria Celeste heard the condemnation she suffered desperately and wrote:

"My very dear Father: This is the hour for you to appreciate more than ever the wisdom which God has given you and which will enable you to support these blows with the grandeur of soul that your religion, your profession, and your age command."

She never spoke of her own unhappiness, but sought to comfort him.

Galileo left for Siena without seeing any of his friends. But Fra Buonamici, solicitous of his reputation, sent an account of the suit to Germany, Holland and Spain. His story threw the entire responsibility of the proceedings on to the Jesuits, especially Father Schreiner. He said they were jealous of Galileo's glory and that it was they who had denounced the scientist to the tribunal of the Holy Office "open to all accusations." He added:

"It is typical of their mania for persecution. Father Firenzuolo, who is a great friend of His Holiness, knows more about architecture and economics than of preaching and theology. He is the arch enemy of Father 'Monster', who had approved the book. Firenzuolo's aim is to attack and destroy Father 'Monster' and Monsignor Gianpoli, and the Pope did not see his way to refuse him this opportunity to pick a quarrel with Galileo, and so permitted him to be summoned to Rome. . . . The accusations were first directed against Father 'Monster', who managed to justify himself. . . . Seeing that he could not involve Father 'Monster', and in order to justify his actions . . . urged on by Galileo's old enemies . . . (the Jesuits), Galileo was transported before the Congregation of the Holy Office where he strongly abjured the Copernician theory, although this was superfluous since he had never adopted or defended this opinion, and had simply discussed it."

This document was really misleading, not only because of its incoherences, but because it tended to show that the whole thing was an intrigue of adventurers of whom Galileo was the incidental victim. The story was so incredible that it might almost have been discredited if its author had not confirmed it elsewhere. A great many others imagined that the machinations of the Jesuits explained all Galileo's misfortunes, and the scientist himself half believed it.

But it was not so. Even if the Jesuits did not play a very pretty part in the affair, their influence could only have been indirect. The Holy Office often consulted the Jesuits of the Roman College on philosophic

and scientific points. It is possible that they did not give a favorable reply when questioned regarding Galileo's latest opinions. But their machinations were only a side issue in a clash of minds and creeds which reached its climax at the sittings of an outworn social structure dominated by theology and in blind conflict with modern thought.

Chapter XXXV

THE PRISONER OF ARCETRI

IN OBEDIENCE to the order from Rome the Inquisitor of Florence on June twelfth called together all the mathematicians and philosophers, and in the presence of the counsellors and members of the Holy Office, read them the text of the sentence and the abjuration. This ceremony was not secret; on the contrary, they were urged to communicate it to Galileo's friends and all who interested themselves in science.

The same instructions were sent to all the apostolic centres, particularly in towns where Galileo had lived or even only stayed a short time. Each Inquisitor was to make it his business to get in touch with any one who had shown an interest, even indirectly, in Galileo and the new science.

They not only did this in most of the large cities of Italy, but even abroad. In Padua the news was placarded in the libraries frequented by professors and men of letters. The university rector of Douai carefully insisted that his college had always mistrusted the paradox of the stability of the sun. The Church's aim in spreading the condemnation and abjuration of Galileo was to stifle all attempts to uphold an opinion which had been judged contrary to the Scriptures.

Galileo arrived in Siena. Bishop Piccolomini immediately informed Cardinal Antonio Barberini, and promised him that the orders of the tribunal would

be punctiliously executed. It was a privilege for Galileo to be allowed to live with Piccolomini, whose house was luxurious. This friend did everything he could to minimize the severity of the philosopher's imprisonment.

It was too good to last. Before he had been there long, secret agents of the Holy Office sent the following denunciation to Rome:

"Galileo has spread in this town opinions that are far from Catholic. The Archbishop, who is sheltering him, has implied to many people that Galileo has been unjustly punished by the Sainted Congregation and that he should not have been made to deny philosophic opinions based on irrefutable mathematical proof."

They added that the Bishop was supposed to have said that "Galileo is the greatest scientist in the world," and that "he will live forever, thanks to his writings, in spite of the prohibition", and that "he will be upheld by the most learned modern men." "Because these words proceed out of a mouth of a prelate, and therefore might produce pernicious results, we make them known to you."

Evidently the Cardinals of the Sainted Office accepted this accusation literally and considered sending Galileo elsewhere.

When Sister Maria Celeste heard of Galileo's unhopd for release she was filled with profound gratitude. She did not quite understand how it was possible. In order not to worry her, Galileo avoided giving her details which would make her too unhappy, and merely wrote rather vaguely that the affair had been concluded to everybody's satisfaction. But the least thing

about her father was of the most vital importance to her, and she wanted to know more. She asked relatives and friends who came to see her at Arcetri for further information.

They lied as best they could. She only heard the whole truth three months later through the Abbot Gherardini, who was ultimately one of Galileo's biographers. When he told her of the sentence and abjuration she suffered agonies. Religious fear mingled with her filial emotions. As if to offer herself as a living sacrifice, not content with pouring out her heart with prayers for the salvation of her dearly beloved parent, she had an inspiration. The mystic idea came to her of taking the penalties imposed on her father on her own shoulders and saying in his place the penitential psalms which were part of the sentence. She would gladly have suffered the direst penalties if only she could have helped her father.

His daughter's love, and his desire to complete certain works, were now Galileo's only reasons for living. Fate had apparently abandoned him. So he begged for banishment to Arcetri for the remainder of his days.

In December, the Cardinals of the Holy See authorized him to establish himself at Arcetri. They were only too anxious to get him away from Piccolomini.

Galileo installed himself near the convent in a villa which he rented cheaply from one of his former pupils. Three months later he was taken seriously ill. The distance from town and the appalling state of the roads in winter did not permit him to receive the care which he needed, so he summoned his courage to appeal once more to the Holy Office, asking permission to live in town until the crisis was over.

This was refused. The Congregation of March twenty-third answered:

"His Holiness has not seen fit to accord such a license, and he has given orders that the Inquisitor of Florence be written to and Galileo be told that he must abstain from all such petitions if he does not wish to force the Congregation to recall him to the presence of the Holy Office."

It was just what might be expected from this inhuman tribunal, in whose eyes suffering and privation were salutary remedies for the salvation of the sinner.

His troubles were not over. While he was dragging out his days, tortured by physical pain and insomnia, Sister Maria Celeste was dying. She had thought that with her father near her she would have the consolation of being able to devote herself to him. But when she saw the shadow of death threatening her idol, and then realized that the Pope had refused the sick man his request, she lost her courage. She died as she had lived, praying for her father until the end.

Galileo's only joy had been the occasional hour he had spent with his daughter at the neighboring convent. It was the only visit he was allowed to make; it had meant everything to him. His daughter's death was the ultimate tragedy. What was there left to live for? But his genius was greater than his human force, and his will to live dominated his will to die. In this supreme moment of physical abnegation it opened a door to him and inspired him to go back to work and write the greatest work of all times.

This was the summing up of the basic principles of mechanics, "The Laws of Motion And The Resistance of Bodies." It embodied the story of three cen-

turies of physical science. He forgot his profound distrust of the justice of men and Nature, and proved once for all that he was greater than his judges and his times.

At the end of the year 1634 Galileo completed this treatise, but he continued the work of perfecting his theories because he realized that the centuries would judge him by this particular work. "It is," he said, "the outcome of my extreme agony, and I esteem it most of all my works because everything therein is new and is mine."

He sought desperately to save his ideas from destruction and oblivion and longed to see the work printed before his death as a vindication of the humiliation which had overwhelmed him. It would be the supreme compensation for his sufferings.

Giovanni Pierone, former professor of architecture at Florence and at this time in the service of the Emperor of Germany, proposed to edit the work. The same offer was made by Pierre de Carcavy, Counsellor of the Parliament of Toulouse, who later became conservator of the Royal Library and member of the Academy of Science. Miccanzio was also watching for a favorable opportunity in Venice. In spite of the decree which forbade Galileo to correspond with his friends, he had managed in devious ways, especially thanks to the intervention of the Grand Duke's secretary, Boccineri, to receive letters which comforted him and made him feel less entirely abandoned by the world.

Niccolo Fabri di Peiresi, a great man whose house was an intellectual centre, had at one time received Cardinal Francesco Barberini as his guest. He wrote to him frankly: "It will be difficult for you to prevent

posterity from showing Galileo the great gratitude he merits for the admirable discoveries which he has made thanks to his telescopes and his marvellous genius. . . . The future ages may find it strange that after the retraction of an opinion which had not been categorically prohibited, so much severity should have been evinced towards a man of Galileo's age. . . . Having made inquiries regarding Galileo's fate. . . . I was told that he is confined in a villa near a convent in which his daughter has just died. She was his only consolation. It seems that he has also been forbidden to receive visits and letters from friends, and also to enter the town and go to his own house. This news . . . moves me to tears. That a man, after having received honors and every sort of homage, a man whose memory will live throughout the centuries, should be thus humiliated! . . . It will be a blot on the splendor and reputation of this Papal reign if Your Excellency does not decide to take Galileo under your protection and show him some consideration. . . ."

Unfortunately Cardinal Barberini had no power to change the philosopher's destiny.

Galileo learned that an order had been given in all Catholic countries that no work of his was to be printed, no matter what its subject might be. On the other hand, books were appearing on all sides in which the weapons of theology were used to attack the ideas which Galileo had promulgated during his long career, while he himself was reduced to a silence which made victory easy for his enemies.

"The one and only reason for my downfall," Galileo wrote from his prison at Arcetri, "is that of having discovered innumerable mistakes in the doctrines assumed for centuries in all schools. I have aroused such

hatred in the souls of those who wish to be considered learned, that, thanks to their cleverness, their ability and their influence, they have known how to find the means to suppress everything that I have discovered and published, and to prevent the publication of that which was yet to come. They have managed to extort from the supreme tribunal a rigorous order forbidding license to any of my works. This order, I repeat, is absolute, for it bears not only on published works but those in preparation.

It is obvious that Galileo was referring to the Jesuits. He was convinced that they were the implacable instigators of his persecution. Time has proved that this belief was sheer exaggeration. The action of the Jesuits may have counted in the balance, but it was by no means the unique or acute cause of the drama.

The publication of Galileo's new manuscript became a most delicate problem. Because of this, a member of the Medici family, Prince Mattias, the son of Cosimo II, took Galileo's manuscript with him to Austria. He gave it to Pieroni personally. The moment Pieroni had his hands on it he took secret steps to ensure powerful collaboration. But it did not take him long to find out that the Emperor was completely under the influence of the Jesuits, especially that same Schreiner who had written the articles on the sun spots.

Obviously Vienna was not a favorable place for the publication of Galileo's work. So Pieroni left for Moravia in order to confide it to a friend who was Cardinal Dietrichstein's printer at Olmütz. Ultimately he had to abandon his project. For this admirably equipped publisher lacked a staff, most of his employees having gone to the Thirty Years' War which

had just broken out. So Pieroni preferred to return the manuscript to its author.

But Miccanzio, Galileo's faithful Venetian friend, was on the alert. During the second half of June, 1636, one of the brothers Elzevir, the famous Dutch printers, arrived in Venice. Miccanzio immediately got into touch with him and opened negotiations. Galileo was not unknown to this printer who had already published the letter to Christina de Lorraine. Holland was an independent heretic republic, and no orders from the Vatican could interfere with its publications. Elzevir accepted the proposition, and Galileo successfully conveyed the four Dialogues to Miccanzio. These four Dialogues constituted his entire manuscript. Nothing was lacking but the title and the dedication, which were very important because it was necessary to find a compromise in order to avoid fresh reprisals. It was vitally necessary to proceed with the utmost caution, for naturally the attitude of the Holy Office had not changed towards Galileo with the years.

At a propitious moment in 1636, Ambassador Niccolini told the Pope that, in spite of what had been rumored, Galileo had never meant to caricature him in the ludicrous character of Simplicio. The Sovereign Pontiff replied: "We believe it. We believe it." But he added that the reading of the "Dialogue" was pernicious to Christianity. Later François de Noailles, Ambassador of France to the Vatican and a former pupil of Galileo's, also essayed to intervene. He was no more successful than Niccolini. However, when the moment came for him to return to France, he did manage to obtain permission for Galileo to meet him at Poggibonnsi. This most gracious gentleman did not want to leave Italian soil without taking leave of the

scientist and expressing his veneration for him in person. The meeting took place on October sixteenth, 1636, and led to a proposal designed to spare the philosopher fresh hostilities when the moment came for the publication of "Two New Sciences." Count de Noailles was to appear to have borrowed a copy of the manuscript from Galileo and to have had it printed without the author's knowledge. That is why Galileo's preface read:

"I am informed without previous warning that my work is in the press and that I must make a decision regarding my dedication and forward my ideas on this subject as quickly as possible."

It was a carefully premeditated improvisation!

Chapter XXXVI

THE LIGHT FROM WITHIN

THE end of the year 1636 was fraught with good omens. Miccanzio had reached an understanding with Elzevir, and the Count de Noailles had taken the book under his protection. Then Elie Diodati, the famous consulting jurist in Paris, opened negotiations with Hugo Grotius, the brilliant author of "Rights of War and Peace" and a statesman of great influence. He suggested that Holland might well consider Galileo's calculations on longitude. Grotius immediately wrote to the inventor saying that his greatest ambition was to be counted among his disciples and that he ardently wished to do his share towards making Galileo's immortal works known.

Lorenzo Real, the Governor of the East Indies, was entrusted with the task of presenting the invaluable discovery to the public. It was welcomed with enthusiasm. Considerable sums of money were voted for a suitable installation, for the purchase of the necessary instruments and the organization of an observatory.

Five months later, April twenty-fifth, 1637, the generous State of the United Provinces of the Netherlands expressed their gratitude to Galileo and announced that as a testimony of their appreciation they were sending him a gold chain worth two hundred écus. After thirty-five years, the invention which

had cost Galileo so much sleep and so much heartache was at last put to practical use. A great naval power adopted it, and he actually saw it applied to navigation before his death.

This encouraged the prisoner of Arcetri, who began to take fresh interest in his researches and in life in general. He recommenced his observations of the skies and established the relation of the three lunar periods, diurnal, mensal and annual, to the corresponding movements of the tides, acknowledging the proof against which he himself had fought for so long, of the attractions of the oceans by the moon. Here was the true explanation of ebb and flow. On November seventh, 1637, he confided this revelation to his friend, Fulgenzio Miccanzio. That was perhaps his greatest triumph. When a man at seventy-three years of age is big enough to admit that he is mistaken and that his unscrupulous adversaries are right, when a man has the intellectual loyalty at an age when opinions are set, to make a revision of values, it is a proof of a mental lucidity and vigor which commands the highest admiration. It was the proof that Galileo in spite of all the vicissitudes of his long life had conserved the pure flame of enthusiasm and scientific faith. Hope returned to his soul. He waited gracefully for the victories that were to crown his career and consecrate it.

In June, 1638, a rumor reached Florence that a special envoy from the Netherlands was to bring magnificent gifts to Galileo. It was also commissioned to receive instructions from the scientist in person regarding the method of establishing longitude. Informed of all this by its secret agents, the Holy Office issued the following order to the Inquisitor of Florence:

"If the person in question is a heretic or from a heretic city, forbid him access to Galileo and forbid the latter to receive him. If the person is a Catholic and from a Catholic city, do not prevent the negotiations unless it is a question of the movement of the earth."

So Galileo was forced to refuse the gifts from Holland under the pretext that he was not in a position to complete the negotiations. He dared not reveal the real reason. It was wiser to renounce the actual honors than to risk compromising the publication of the book which was the ultimate aim of his life. Elie Diodati saw the danger too and wrote to the authorities of Holland advising them to postpone the visit of the technical commission.

A new and most terrible menace now threatened Galileo. His eyesight was failing! Every day his contact with the world diminished. His heart ached. Isolated from the outer world, was he also to be cut off from Nature, his great love whose laws he had so loyally interpreted? Might it not be granted him to see the fruit of a lifetime of thought and incessant labor before he completely lost his sight? The news reached him that his work was printed. Some of his friends had already seen it; but by some irony of fate, he who counted the days and hours, had not yet received his copy. Either thanks to a singular negligence on the part of the editors, to the fact that distances were so great and so difficult to cover, he did not receive a copy of his work until some months later. It came too late. Completely blind, Galileo only had the cold comfort of holding it in his arms.

Thanks to Diodati, the book was dedicated to the

Count de Noailles. Moved to tears when he read the dedication, and hearing of the tragedy which had befallen Galileo, the Count wrote:

"You could not have addressed your excellent work to anybody who prizes and estimates its merits more than I. Apart from the fact that the thoughts therein are new and powerfully proven, they are expressed with so much clarity and grace that there is nothing to add to it. In a word, if I am capable of judging it, everything in it is worthy of the rare sufficiency which has acquired for you the reputation of being the foremost mind in Italy. I am taking care that it be read attentively at this Court with equal fruitfulness and pleasure by all who are acquainted with these matters.

"There is nobody who does not regret as I do the accident which has happened to your sight as a misfortune which may deprive this century of an infinity of these wonderful visions with which you have illumined the sciences you have exploited.

"In any case, dear sir, if it is the mind which sees and which watches, according to what has been said in olden days, unless I am mistaken, by I know not which philosopher, it must be hoped that you will continue to dissipate the shadows which still remain to be penetrated. Nothing can take from your great spirit its quality which is like unto the sun. It must ever work according to its inspiration, both for its own glory and for the commonweal of studious men.

"It is that which consoles me in the dismay with which I receive the news of your affliction

and to which I would gladly give other comfort than mere prayers and wishes. I beg you to favor me ever with your good grace, and I do assure you that, esteeming you as I do with all the rest of mankind as one of the great ornaments of our age, I shall never believe myself worthy of your friendship until I have found the occasion to prove to you effectively, that I am, dear sir, your most humble and very affectionate servant."

He was the ornament of the century, to quote the Frenchman's touching phrase, but from now on he was to be a useless ornament. Blindness in conjunction with illness and moral suffering prevented any further work. The eyes which had penetrated heavenly secrets hitherto unsuspected, and had observed the greatest wonders of the universe, had failed. Galileo's sole remaining resource was having other men's works read aloud to him, and occasionally dictating when his strength permitted him to concentrate sufficiently. Insomnia tortured him. He had little strength left. Still he did not lose his indomitable courage. The scientists of the world had placed their hope in him. Father Mercene in Paris had translated and published his "Mechanics". His disciples were consulting him and working according to his directions. He had one more duty to perform. An inner light radiated from his soul. His final task was clear. He must guide and encourage those who were to carry on the building of the scientific edifice of which he had laid the foundations.

Benedetto Castelli hoped against hope that the master might recover his sight, and with this object in view, helped him to try and get permission from the

Roman authorities to go to Florence for medical attention. The Holy Office consented to lend a favorable ear to his request, but not without first making considerable inquiries as to whether the old man's condition was really sufficiently serious to justify the concession. It was only after receiving the assurance that the prisoner had one foot in the grave, and that he was no longer dangerous or capable of making seditious speeches, that they finally gave the authorization. The Inquisitor of Florence, in order to pacify the Holy Office, assured the authorities that Galileo would be guarded by his son, Vincenzo, who would not willingly permit visitors because he would obviously wish to spare his father anything that might endanger his life. The Inquisitor added with bitter cynicism that Vincenzo might be trusted as it was in his own interests to watch his father jealously. This was true, since he still collected the annual pension of one thousand écus that the King of Tuscany had attributed for life to his court astronomer.

But Galileo did not stay long in Florence. The doctors were unable to do anything for him. Back in his villa at Arcetri he continued to spend his endless days in enforced darkness. He listened to the news which was read to him. The Grand Duke was authorized to visit him. Putting aside all formality, he remained at the sick man's bedside for more than two hours. It was the least he could do!

In October, 1639, a young professor, Vincenzo Viviani, begged Galileo for the inestimable favor of being allowed to enter his service. The only reward he asked was Galileo's advice and teaching. Viviani was his last disciple and his very dearest. The collaboration was fruitful. Following his Master's indications,

Viviani wrote a dialogue which completed "The Two New Sciences." From Galileo's own mouth he heard facts which he incorporated in his biography published much later as an introduction to Galileo's complete works. These were published under the auspices of the Prince of Tuscany.

A year later, in Padua, the philosopher Liceti wrote a book entitled "A Stone of Bologna". It contained an adverse criticism of Galileo on the subject of the secondary light of the moon. At the Crown Prince's request Galileo dictated an answer proving that the light resulted from the reflections of the sun's rays on the terrestrial globe. This was his last polemic.

Evangelista Torricelli, Castelli's secretary and pupil, expressed a great longing to come to Arcetri. Unfortunately he was not able to realize this wish until November, 1641, just three months before Galileo's death. But this brief collaboration made him the heir to and promulgator of Galileo's science with Viviani. From the dying man's dictation he wrote a commentary of the definitions of the theorems of Euclid which enriched the scientist's last work.

This was the last effort Galileo ever made. In November, 1641, a slow fever took hold of him. On January first, 1642, his condition became serious. His friends saw that there was no hope.

On January eight, 1642, at four o'clock, he died peacefully, surrounded by his two faithful disciples, Viviani and Torricelli, his son and his daughter-in-law. "His body," writes Viviani, "was transported from his villa in Arcetri to Florence, and there, by order of the Grand Duke, was buried apart in the Church of the Holy Cross (Santa Croce). The ancient sepulchre of the noble family of Galilei stood there, and

plans were made to erect a sumptuous monument to him in the most conspicuous part of the enclosure.

Informed of this pious intention, the Inquisition decided to persecute the scientist even after death. Its representative was ordered to inform the sovereign that "It was not becoming to raise a sepulchre over the corpse of the said Galileo who had been punished by the Holy Office and had died while still purging his fault, for such a deed might produce a scandal prejudicial to the piety of the Grand Duke", and once more the spineless monarch bowed before the injunctions of the Holy See.

Galileo had made a will. His son Vincenzio was his principal heir. He left a small sum to his second daughter Arcangela and also ensured a sufficient income to his nephews at Munich. After his death the Holy Office opposed the testament under the pretext that a heretic had no right to dispose of his earthly goods. Fortunately a theological consultation in Florence decided that the act was valid, and that after abjuration and penitence there was no reason to consider the culprit a heretic or confiscate his belongings.

Galileo had designated Evangelista Torricelli as his possible successor as Court Mathematician, but Torricelli did not live long. Vincenzo Viviani replaced him. He later became very famous. The inscription to the glory of his master engraved on the façade of his house in the Via del' Amore was inspired by him.

Unable to overcome the prejudices of the Inquisition while alive, he left a will requesting his heirs to raise a sumptuous tomb over Galileo's grave as soon as it became possible. It was J. Binelli, his executor, who in 1737, raised a monument symbolizing Geology

and Astronomy in the church of Santa Croce where Machiavelli and Michaelangelo also lay buried.

This was a century after Galileo's death. The Inquisition no longer opposed the erection of the monument, but demanded to see the epitaph before it was engraved on the pedestal in order to make sure that it contained nothing offensive to the Holy Tribunal.

According to his wish, Viviani was exhumed and placed beside the man he had so deeply venerated and whose last thoughts he had been most instrumental in spreading.

Conclusion

IT WAS not until April sixteenth, 1757, that the Congregation of the Index decided to raise the interdiction on the work which taught that the sun was the centre of the world and that the earth moved, though they did not cut Galileo's works categorically off their black list. In spite of this decision, Father Anfossi, master of the papal palace in 1820, refused his consent when asked by Joseph Setelle, a professor of Rome, for permission to print a treatise on astronomy incorporating Copernicus' views. He alleged the decree of 1616. The printer objected that the decree was ancient history, but the prelate answered that "religion has not changed, and the Bible is always the same." Setelle then addressed a memorandum to the Pope in which he said substantially that since the discovery of the gravity of air by Torricelli, the system of Copernicus was no longer similar to the one that had been condemned in Galileo's day, and there was no longer any reason to fear the inconsistencies which had been the outcome of Copernicus' opinions. "Besides that," he added, "it has been proven, thanks to the works of Newton, that the sun is on the threshold of the ellipse of the planets and not in the centre of the universe."

This letter made no impression. After renewed entreaties, the Congregation finally accorded the author the right to publish his book on condition that he explained those differences, thereby proving that the

doctrine championed by Galileo did not comport decisive proofs apt to bring about conclusions opposed to the Scriptures. Thanks to this bias the Inquisition made itself not only the upholder of orthodoxy, but the protector of the new science; and the Church, thanks to specious compromises, tolerated a thesis contrary to the Scriptures from that time on.

"This vain presumption of omniscience," Galileo had said, "can only originate from never having understood anything." He knew that sooner or later they would be obliged to admit his propositions because the power of the truth is such that, in seeking to oppress it, the very attack exalts it and confirms it. "It is not in ancient tomes," he added, "but in close observation and personal consecration that a grain of truth may be found. It is so very easy to seek the significance of things in the papers of this or that man rather than in the works of nature which, ever alive and active, are constantly before our eyes."

Galileo was not only the destroyer of scholasticism—"that insanity composed of a misunderstanding of the Bible and of Aristotle," as Renan has said. He was not only the restorer of the purest traditions of antiquity and of mathematical knowledge, the untiring explorer of a vast celestial universe, the penetrating observer of nature in whose midst his contemporaries lived with their eyes shut, and the inventor of a multitude of instruments which supplemented man's natural faculties and gave access to the most astounding facts; he was not only content to establish the laws of inertia, the laws of oscillation, the laws of weight and the laws of movement; he was not only the greatest scientist in the modern sense of the word. Any one of these titles to glory would have sufficed to

immortalize him. But he was not the contemporaneous hero of his epoch leaving nothing but dead facts behind him. He was a living conqueror whose exaltation still carries men off their feet. He is still the breath of life to all seekers. His experimental methods can be traced in all scientific research. He brought an inseparable alliance into the realm of reason and observation, governed by positive and inviolable rules. He not only left an immense and prodigious treasure of personal accomplishment, of which the barest outline staggers the imagination, but he created the infinite possibility of eternally new conquests over the forces of nature.

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